ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXIII. No. 24.

TABLE OF CONTENTS.

Engineering News of the Week 553, 554

Technical and Illustrated Articles:

Elevated Railways in Boston 554
The Application of the Compound System to Locomotives in Russia 554
The Nitrate Deposits of Chili 556
A Compressed Air Hospital 557
Josiah Meigs and the U. S. Meteorological Bureau 558
Track for Street and Other Railways 558
The Iron Mines of Santiago de Cuba 558
Statistics of Railway Construction 559
Hauling Locomotives Over Country Roads 561
An Experimental Study of Air Resistance 561
Cost of Motive Power on French Canals 568
Steel Plate and Malleable Iron in Car Construction 568
Steam Heating and Ventilation of Passenger Cars 569
Standard Journal Box, Bearing and Lid 570
Storage Battery or Accumulator Traction in England 570
Experiments as to "Imperceptible Slip" in Locomotive Drivers 571
To Find a Leak in Underground Pipe 571
The Highways of the Grand Duchy of Hesse 571

Personals, Society Proceedings 563

Editorial Notes 564

Papers to be Read at the Creason Convention of the Am. Soc. C. E.—City Transit for New York—Official Representation at American W. W. Assoc.—"Imperceptible Slip" in Locomotive Driving Wheels—Implements of War for Use of Naval and Military Schools—Risks of "Record Breaking."

Editorials:

Railway Construction in the South 565
The Master Car-Builders' Convention 566

Correspondence 567

The Late Moses Lane—Wellington's "Engineers' Field Book"—Table for Computing Right of Way Areas.

Railways, Rapid Transit, Highways, Water-Works, Bridges, Tunnels and Canals, Electrical, Sewerage and Municipal, Contracting, Proposals Open, Manufacturing and Technical 571, 576

ENGINEERING NEWS.

SOME FINE EXPRESS LOCOMOTIVES are in use on the Great Southern & Western Ry. of Ireland for hauling the mail trains between Dublin and Queenstown, in connection with the Atlantic steamers. The road has the Irish gauge of 5 ft. 3 in. The engines were built at the company's works to designs prepared by Mr. IVATT, Locomotive Superintendent. They have four coupled driving wheels and a four-wheel leading truck of the American swing link pattern. The principal dimensions are as follows: Cylinders, 18 × 24 ins.; driving wheels, 6 ft. 6 ins.; boiler, 9 ft. 9 ins. long, 4 ft. 3 ins. diam.; tubes, 204, 10 ft. long, 1¾ ins. diam.; boiler pressure, 150 pounds per sq. in.; fire-box, 4 ft. 10 ins. long; 3 ft. 11 ins. wide, 5 ft. 9 ins. high above grate. Heating surface, fire-box, 112 sq. ft.; tubes, 938 sq. ft.; total, 1,050 sq. ft., grate area, 18¾ sq. ft. Weight, on truck, 30,352 lbs.; on driving wheels, 28,784 lbs.; on trailing coupled wheels, 23,672 lbs.; total, 87,808. The tender is carried on six wheels; it has a capacity of 2,700 galls. of water and four tons of coal. Weight of tender, 63,392 lbs. The distance is 177¼ miles, without severe grades. The schedule time is 4 h. 35 min., with 18 mins. for stops, giving an average speed of 42.16 miles per hour. The running speed is 45 to 50 miles per hour. The weight of the train averages about 187¼ tons, including engine and tender.

THE BROAD ST. RAILWAY CO., of New York, has been organized with a capital of $300,000 to construct and maintain a street railway, commencing at South Ferry and running along Whitehall, South, Broad, William, Park Row and Nassau Sts. Among the directors are Wm. F. HAVEMEYER, ROBT. L. CUTTING, and CHARLES C. EDDY.

A TORPEDO BOAT of novel design has been patented by a trustful, and, we fear, reckless inventor. The boat is provided with an engine, boiler and propeller, a shell-proof deck, and has a steam launch in tow. In operation the boat would be partially submerged and rush at the enemy at full speed; at a convenient distance all but the Captain and one man would take to the launch, and when the torpedo was close to its object these two would jump overboard and be rescued by the launch. Explosion of the charge is to be produced by contact. As the chief purpose of this invention is to use very heavy charges of a high explosive, the inventor does not seem to have figured on the effect of this explosion upon anything within a radius of 500 yds. Like dynamite-fishing, the chances are great that, while the enemy's ship might suffer, the Captain in the water and the steam launch and its crew would also be "knocked silly" at the same time. We would prefer that the inventor did his own steering for the first trip.

BIDS FOR THREE NEW WAR-SHIPS, to cost more than $5,000,000, were opened at Washington on June 10. The largest is an 8,100-ton armored cruiser, No. 2, to be armed with six 8-in. and twelve 4-in. breach-loading rifles. She is to develop 16,000 horse-power and have a speed of 20 knots. The dimensions will be: Length, 380 ft.; extreme beam, 64 ft. 2½ in.; depth in hold, 41 ft. 3 in. The second is a 5,500-ton cruiser, 330 ft. long, 53 ft. beam and 33 ft. depth. Her armament will be two 8-in. and ten 4-in. guns; horse-power, 13,500; speed, 20 knots. The third ship is a practice cruiser of 800 tons for the Naval Academy. The bids for the armored cruiser No. 2 were as follows: For the vessel, according to the plans and specifications prepared by the Navy Department, the Union Iron Works of San Francisco, $3,100,000; William Cramp & Sons, of Philadelphia, $3,150,000; the Risdon Iron and Locomotive Works, San Francisco, $3,450,000. The Union Iron Works and Cramp & Sons also submitted bids for this vessel according to their own plans and specifications. The former's bid was $3,000,000, and the latter's $2,985,000. There were only two bids for the protected cruiser No. 6, both from the Union Iron Works of San Francisco. They proposed to construct the vessel according to the Department's plans and specifications for $1,796,000, and according to their own plans and specifications for $1,760,000. Only two bids were received for the practice vessel, as follows: F. W. Wheeler, of West Bay City, Mich., at $245,000; Samuel L. Moore & Co., Elizabethport, N. J., at $250,000. Both were in accordance with Department's plans. No awards will be made for several weeks.

A SHIP-BUILDING SYNDICATE is reported as having bought land on the Delaware River, near Philadelphia, for establishing a $5,000,000 plant. The CRAMPS are reported to be part of the enterprise.

NINE NEW WHARVES are to be built at Weehawken for the Erie Railroad, and the plans and specifications for them are now being prepared by Mr. G. E. ARCHER, architect, and Mr. J. W. FERGUSON, assistant engineer of the Erie R. R. The projected improvements will take up 2,400 ft. of water front. The business of the road has increased to such an extent within a year that the present terminal facilities have been found entirely inadequate. The official report of General Agent M. E. STAPLES shows that during last March the company handled 231,391 tons of freight, an increase of 49,000 tons over March, 1889. In 1889 the road lightered 1,039,007 tons of freight and 238,600 tons of grain in this port. The largest of the piers will be 1,100 ft long. A storage warehouse for the preservation of perishable freights and an extensive system of cattle sheds will also be built. Altogether the improvements will cost, it is estimated, about $2,000,000. Twenty-five additional tracks for the storage of cars will be laid. The entire work will be completed this fall, it is said.

THE WORST ACCIDENT OF THE WEEK was that on the Wabash R. R., near Warrenton, Mo., on June 9. Eight cars loaded with valuable horses, running as a second section of a freight train, collided with another freight train; 8 men were killed and 25 men injured, and a number of valuable race-horses killed or badly injured.—On June 6, the Northwestern passenger train, from Freeport to Chicago, was derailed by a broken wheel near Rockford, Ill. The train ran about 200 ft. and then toppled over, wrecking the entire train and killing the engineer and four trainmen, and injuring two section men and several passengers.—On June 6, the Boston sleeper on the Louisville & Nashville R. R. was derailed at a sharp curve near English, Ky., and 8 persons were thrown down a 40 ft. bank; several were seriously hurt, two of whom will probably die.—The wreck of a private car on the Ohio River R. R., 30 miles below Wheeling, W. Va., on June 6, resulted in the wounding of six men, all connected with the B. & O. R. R. and the Ohio River R. R. All are recovering.—Disastrous floods have occurred over a widespread section of the country. Ontario, Can., especially suffered, and six bridges were swept away near Brooklyne, and a considerable amount of railway track was washed out. Washouts wrecked trains on the Erie and Falls Branch of the N. Y. Central R. Rds. The Northwestern States also suffered much from floods. The St. Paul, Kansas City, Illinois Central, and Northwestern railways all lost bridges.

INSPECTORS ON THE CHICAGO WATER-WORKS TUNNEL seem to be having a good time, according to the Chicago *Tribune*. That journal says, in speaking of one part of the work:

> Two shafts are in progress. Only two miners can work on the "face" of the shaft at the same time, yet there are five inspectors of miners at $5 each per day. Only two masons or bricklayers can work at constructing the lining of the tunnel yet it requires five inspectors at $5 each per day to look after them. They do not use a vast quantity of material in fifteen feet of tunnel, but it takes six inspectors at $5 each per day to see that the stuff is all right. Then there is a chief inspector at $6 per day. Thus it takes nineteen inspectors at $5 each per day to watch fifteen feet of work. There were twenty-one inspectors during May. This is more than one inspector per foot. It ought to be well watched.

THE CLEVELAND WATER-WORKS TUNNEL is to be extended two miles or more further into the lake, according to a late decision of the Waterworks Trustees. Engineer WHITELAW estimates the cost of a new iron crib at $200,000 to $250,000, and the cost of driving the new tunnel at $35 to $40 per lineal foot. The total cost would be about $663,000. The building of the new breakwater has practically brought the waterworks crib ⅛ mile nearer the mouth of the Cuyahoga river than before, and the water is in danger of contamination by sewage. The tunnel now being built under the lake will be completed before the proposed extension is commenced. Owing to a streak of soft clay encountered, air-pressnre is being used on this tunnel at present.

THE FRUIT HILL RESERVOIR, at Providence, R. I., is apparently suffering more from leakage than was at first supposed, and the *Journal*, of that city, states that its original Consulting Engineer, Mr. JAMES B. FRANCIS, of Lowell, Mass., has been called to act with City Engineer SHEDD to suggest repairs. Mr. FRANCIS says that it is highly important to first ascertain the cause of the leakage before any repairs are attempted, and advises the removal of the stone lining at the affected points, and an excavation down to the rock.

THE ARTESIAN WELL INVESTIGATING COMMITTEE, made up of Col. E. S. NETTLETON and Prof. ROBT. HAY, has visited El Paso and Fort Worth. They are collecting data of all borings for deep water between the 97th meridian and the foothills of the Rocky Mountains, with the view of ascertaining to what extent this artesian well water can be utilized in irrigation. The States of Dakota, Montana, Wyoming, Nebraska, Colorado, and New Mexico have been thoroughly examined, and Texas will finish the list.

ELECTRICITY FROM HEAT direct, is said to be the subject of a patent by Mr. H. B. Cox, of Maine. Says the Hartford *Courant*, a company has been formed in that city with a capital of $1,000,000, and such firms as Pratt & Whitney, Pratt & Cody and Hyde & Joslyn are mentioned among its incorporators. The machine is not described, but a furnace, from the glowing coals of which the electricity is led without the intervention of any intricate machinery, is said to be the main feature. Public exhibitions are promised in a few weeks.

NIAGARA FALLS BY ELECTRICITY will be one of the features of that famous resort during the present season. The Brush Electric Light & Power Co., of Niagara Falls, is putting in a large number of lights in Prospect Park and at various points near the falls. Large reflectors will be used to concentrate the light on the falls.

THE GULF OF ST. LAWRENCE has been ordered to be surveyed by the department of Marine. Elaborate tidal observations are to be made from the Strait of Belle Isle down.

THE SALVAGE OF THE *City of Paris* amounts to $37,500 to the *Aldersgate*, and $3,000 to the *Ohio*, awarded by Admiralty Justice BUTT.

THE PROPOSED ADIRONDACK PARK, in and about the headwaters of the streams having their sources in this wilderness, would contain about 1,500,000 acres and probably cost $250,000 per annum for some years to come. In accordance with the resolution of the last Legislature, the State Forest Commission

is now gathering statistics for a report on this park.

A REDWOOD TREE, 90 ft. in circumference and 33 ft. in diameter, is being cut for the Chicago Exhibition. The section to be sent to Chicago will be 9 ft. in height and 60 ft. in circumference, and will weigh 65,000 lbs. The tree is taken from the forests of Tulare Co.

ONE OF THE DEEPEST MINES IN THE WORLD is at St. Andre du Poirier, France, and yearly produces 300,000 tons of coal. The mine is worked with two shafts, one 2,952 ft. deep and the other 3,083. The latter shaft is now being deepened, and will soon reach the 4,000-ft. level. The remarkable feature in this deep mine, says a foreign exchange, is the comparative low temperature experienced, which seldom rises above 75 degrees Fahrenheit. The gold and silver mines of the Pacific Coast of our own country, at a depth of half that of the French mine, often have much difficulty in keeping the temperature low enough to admit working. In some levels of the great Comstock lode the temperature rises as high as 120 degrees.

THE SWELLING OF CEMENT, according to recent investigations by the German railways, reported in the *Centralblatt der Bauverwaltung*, is principally due to the magnesia they contain. An examination of the cement used in a bridge which failed recently showed that it contained 24.12 per cent. of magnesia. Many cements, however, which will expand in setting contain very small amounts of this element, and it seems probable that such expansion is not due to one, but to several causes.

THE SUEZ CANAL REPORT for 1889 shows a profit for the year of $7,442,585. The net dividend was 85 francs, or $17 per share. The receipts from night travel amounted to 71 per cent. of the total, as against 46 per cent. in 1888. The average duration of transit has been diminished by four hours. The dividend for 1890 will be 91 francs.

JAPANESE EARTHQUAKES to the number of 100 distinct shocks, are reported by the *Japan Mail* as having occurred on Miyoke Island in the Idzu group, between April 17 and 19. Many houses were destroyed by land slides.

THE IGNITION OF LEAKING GAS FROM A BROADWAY GAS MAIN, at the corner of Fulton St. and Broadway, caused a complete stopping of traffic on that part of Broadway for the greater part of Thursday last. Excavations were being made at the place by the New York Steam Heating Co., and a 16-in. gas main in the trench had been leaking for some days. Early on Thursday morning a workman dropped and broke his lighted lantern, and the gas was set on fire. The men endeavored to smother the flame with dirt, but without avail. In a short time the gas accumulated in the manholes on each side of Broadway exploded, and the manholes were destroyed. There being no means of shutting off the gas except at the gas-house, the pipe had to be plugged at some distance from the scene of the fire. By evening this was accomplished, and the fire was extinguished.

The electric wires in the subway adjacent to the main have been destroyed.

THE ENGINES OF THE NEW CRUISER BALTIMORE are said to cause considerable vibration when she is running at 10 knots per hour. At higher and lower speeds no vibration is perceptible.

A COMMUTATION.—The man who is shocked to death by electricity should be buried in a volt.—*Texas Siftings*. Yes; it would be an appropriate place for his last ohm.—Toledo *Blade*. Since he is sure to dynamo.—New York *World*. Wire you so certain? he might offer you resistance.—*Electro Mechanic*. We intended to remark upon the shocking character of the above, but they came insulate that we are afraid they would hardly pass current.—*Builder and Wood Worker*. What bad attempts to telegraphic story.—*Builders' Exchange*. Watts the matter with the attempts? Coulomb off if you don't appreciate di-electric stories.—Cincinnati *Artisan*.

Elevated Railways in Boston.

The Street Railway Committee of the Massachusetts Legislature has reported to the Senate a bill granting a charter to the West End Street Railway Co., to construct, equip, maintain and operate a system of elevated railways in Boston. The document provides security and restrictions for all the interests affected, and is much too long for reproduction, but its main provisions are summarized as follows:

Permission is given to construct the road wherever the company has the right to surface tracks, and to connect the two systems by inclined planes. A petition for location must first be filed with the board of aldermen of the city or selectmen of the town, with full details as to route and construction. The city or town can grant a location after a hearing, subject to a revocation by a vote of two-thirds the city council, if the public interest so requires. After obtaining a location a plan shall then be filed with the railroad commissioners, showing such details as they may require.

Section 5 declares that the construction as an entirety shall be deemed an additional servitude upon the streets occupied for which damages may be claimed by abutting owners or lessees, but the words owner or lessee shall not include any city or town. After obtaining a certificate of approval from the railroad commissioners the company shall file in the office of the secretary of the Commonwealth a copy of such certificate together with the order for a location, and the governor shall appoint three disinterested parties as commissioners to estimate the damages and benefits, if any, caused by such constructions, such estimates to be filed with the secretary within six months of the time of their appointment.

The railway company is to obtain from abutting owners or lessees within one year from the filing of such estimate either a written release of the damages or their written consent to the location, etc., or shall give a bond prescribed by the commissioners to each owner within six months from the filing of the estimate binding the company for the payment of the damages.

The damages cannot be sued for until the expiration of one year after the granting of the certificate by the railroad commissioners, and must be claimed within the succeeding year. No city or town is entitled to receive damages.

Section 6 provides that when the railway company has obtained a release of damages or the consent in writing of abutting or other owners, or filed the bonds provided for, and issued a certificate of compliance that such releases or consents have been obtained, and filed for record in the registry of deeds a copy of the location and certificate of approval of the railroad commissioners, they may proceed to construct and operate the railway.

The railroad commissioners must examine and approve by certificate the construction before the road shall be opened to public travel. Section 8 provides for the holding of real estate for station or other railway purposes. Section 9 provides that the road shall have the right to cross tide waters under the supervision of the harbor and land commissioners. Section 10 provides for the issuance of the common stock for all the expenses of construction, including the damages. Section 11 relates to restoring the streets to their original condition after making excavations. Section 12 permits the cars to be operated by electricity or such other motive power as the board of railroad commissioners may approve. Section 13 provides for damages to owners of abutting land when the road is constructed on private land.

Section 15 requires the certificate of acceptance of a location to be filed within two years from July 1, 1890, and allows two years thereafter for the construction of not less than three miles of single track or one and one-half of double track.

Section 16 provides that the rate of fare for a continuous ride in the same car, whether partly upon an elevated track or upon the surface, shall not exceed 5 cents.

All the other petitioners have leave to withdraw. The report was laid upon the table. A bitter fight is anticipated in the Senate and House.

HADES AHEAD.—In one respect Detroit is very much worse off than Hades—nobody inspecting its pavements can discover any evidence of good intentions.—*Detroit Free Press*.

The Application of the Compound System to Locomotives in Russia.*

In ENGINEERING NEWS of March 15, was published a partial abstract of a paper by Mr. THOS. URQUHART read in January last before the Institution of Mechanical Engineers at London. The paper treats of the application of the compound system to locomotives burning petroleum on the Grazi & Tsaritzin Railway in Russia.

On April 26 we published a letter from Mr. URQUHART. Accompanying the letter was a set of drawings showing a passenger locomotive with four coupled driving wheels which had been transformed into a compound locomotive. These drawings are reproduced here.

Figs. 1, 2 and 3 show respectively a side elevation on the high-pressure side, a transverse section through the smoke-box, and a horizontal section through centers of cylinders and driving wheels. The cylinders are 17.3 ins. and 25.2 ins. in diameter; piston stroke, 22 ins.; driving wheels, 5 ft. 3 ins. in diam.; weight, 24 tons; working pressure of boiler, 135 lbs.; 6 wheels (4 coupled driving wheels); the high-pressure crank leading in running forward.

The following tables show mean steam pressures and temperatures of steam and the power developed by the engine above described:

TABLE 1.
PRESSURE AND TEMPERATURE OF STEAM.

Cylinder	Cut-off. Number of notch.	Cut-off. Percentage of stroke.	Steam pressure in lbs. per sq. in. Valve chest.	Mean forward	Mean back.	Mean effective† D.	Mean effective† D × 1.1.	Temperature of steam. Beginning of stroke.	End of stroke.	Used in expansion.	Used in both cylinders.
			lbs.	lbs.	lbs.	lbs.	lbs.	deg F.	deg F.	deg F.	deg F.
High-pressure, right hand.	1	20	132.4	88	57	31	34	356	286	70	
	2	50	132.4	110	55	55	60	356	306	50	
	3	70	132.4	125	54	71	78	356	329	27	
	4	80	132.4	132	53	79	87	356	342	14	
Low-pressure, left hand	1	42	55.88	34	7.1	26.9	30	302	243	59	113
	2	60	56.61	43	4.3	38.7	43	303	257	46	99
	3	78	57.35	48	2.0	46.0	51	304	273	31	83
	4	86	57.79	53	1.0	52.0	57	305	286	19	70

* The point of cut-off in percentage of stroke is given as marked from the valve setting.
† The mean effective pressure in column D is the difference between the mean forward and backward pressures; in column D × 1.1 it is increased by 10 per cent. to allow for the throttling effect of the indicator pipe and connections.

TABLE 2.
POWER DEVELOPED.

Point of cut-off.	Speed of train. Miles per hour.	Driving wheels. Revolutions per minute.	Piston speed. Feet per minute.	Indicated H. P.	Tractive power, tons.	Ratio of tractive power to adhesion weight.
						% ratio.
1	33	176	646	463	2.151	9.09 = 1 to 11
2	27	141	518	552	3.427	13.88 = 1 " 7.2
3	20	106	387	539	4.217	17.00 = 1 " 5.8
4	13	70	256	475	4.746	19.23 = 1 " 5.2

TABLE 3.
COMPARISON OF POWER DEVELOPED BY COMPOUND AND NON-COMPOUND PASSENGER LOCOMOTIVES, DRAWING EQUAL TRAINS AT EQUAL SPEEDS ON THE SAME TRACK. REVOLUTIONS 53 PER MIN. PISTON SPEED 194 FT. PER MIN.

ENGINE.	Point of cut off.	*Mean effective steam pressure. Pounds per sq. in. H. p. cylinder.	*Mean effective steam pressure. Pounds per sq. in. L. p. cylinder.	Indicated H. P.	Tractive power, tons.	Ratio of tractive power to adhesion weight.
		lbs.	lbs.			% ratio.
Compound	1	35 2	30.5	139	2.35	9.8 = 1 to 10.2
	2	60.1	44.4	215	3.63	15.1 = 1 " 6.6
	3	79.3	51.6	263	4.44	18.5 = 1 " 5.4
	4	89.5	58.2	297	5.01	20.9 = 1 " 4.8
Non-compound	1	87.5		241	4.07	16.9 = 1 " 5.9
	2	108.2		298	5.04	21.0 = 1 " 4.8
	3	115.0		317	5.35	22.3 = 1 " 4.5
	4	116.3		321	5.42	22.6 = 1 " 4.4

* The mean effective pressure is the difference between the mean forward and backward pressures, + 10% to allow for the throttling of the steam in the indicater pipe.

* Abstract of paper by Mr. THOMAS URQUHART, read before the Institution of Mechanical Engineers, at London.

In Table 3 we show the results of experiments made by Mr. URQUHART to determine the relative tractive powers of compound and non-compound locomotives, when the compound are transformed from the non-compound without increasing the original boiler pressures, and retaining one cylinder automatic, but moved by the hand of the driver. The locomotive shown in our illustration has a hand interchanging valve as well as a hand intercepting valve, so that the engine may be used as a non-compound one for any length of time, instead of only at starting. The interchanging valve serves as an air-valve when steam was shut off. The objectionable cooling of the cylinder resulting from this method was partly obviated by a perforated pipe connecting the receiver with the smokebox and thus mixing the hot gases from the smokebox with the incoming air. There are, of course, drawbacks to the method,

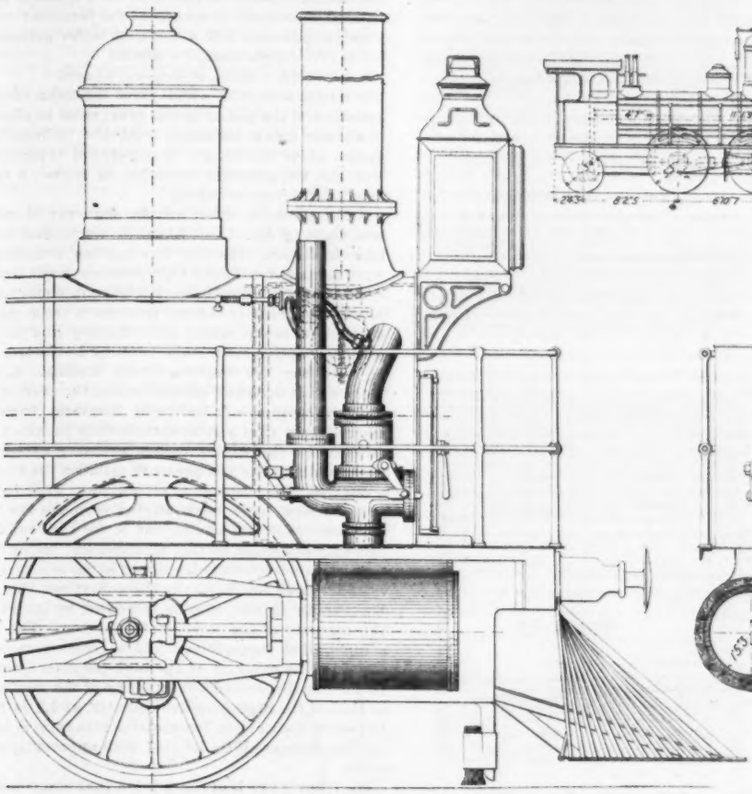


Fig. 1.—Side Elevation.

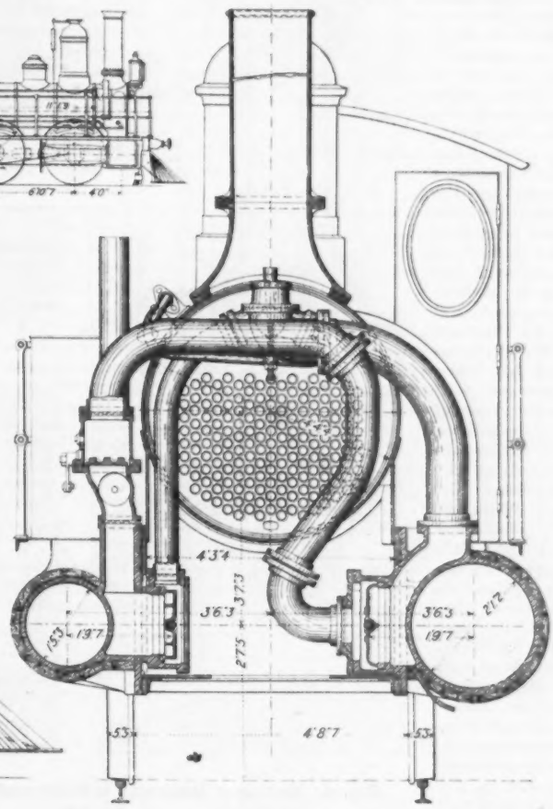


Fig. 2.—Transverse Section.

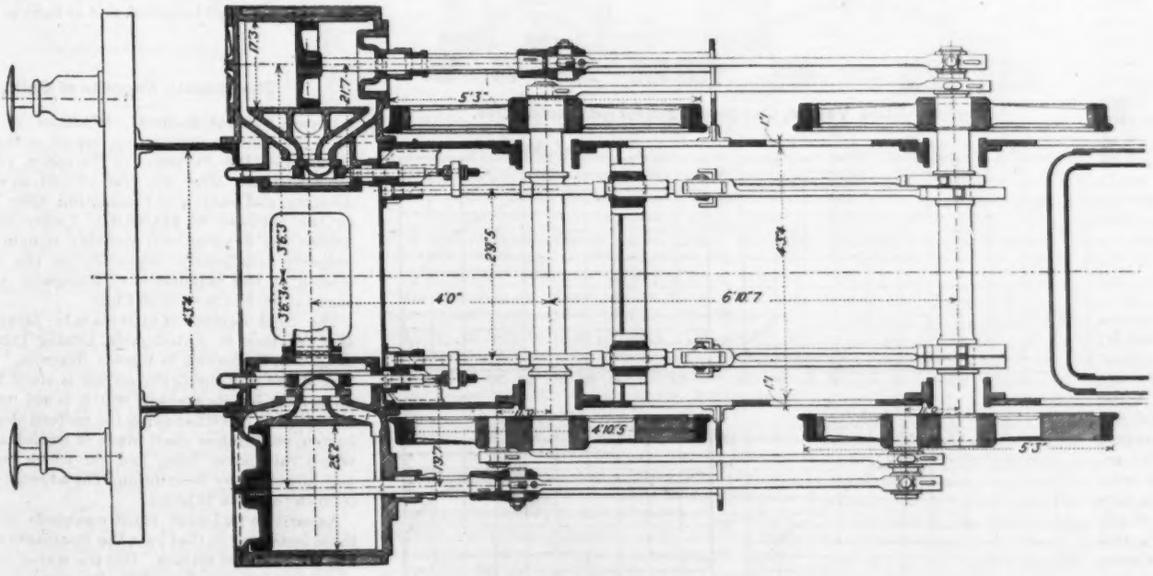


Fig. 3.—Horizontal Section.

Compound Passenger Locomotive, Grazi & Tsaritzin Ry., Russia.

of the non-compound to form the high-pressure cylinder of the compound. Trial trains of equal weight (345 tons exclusive of engine) were made up for each locomotive. A dynamometer was placed between the tender and the train, and indicator diagrams (see Figs. 4 and 6) were taken at every notch, the trains running 11 miles on an up grade, at equal speeds of 10 miles per hour.

The starting valve for admitting steam direct from the boiler into the low-pressure cylinder is not inlet valve for both cylinders when running down grade with steam shut off.

After the first compound passenger locomotive had been put in regular service it was observed that it ran down grade very stiffly, so much so that in was necessary to open the regulator a little. This resistance proved to be due to the creating by the low-pressure piston of a vacuum in the receiver, and it was overcome by fitting on to the receiver an air inlet valve which enabled the piston to pump in air but it has been found more profitable to do this than to keep steam on while running down grade.

In 1886, Mr. URQUHART, who had doubts as to the advisability of compounding locomotives, obtained leave from the Russian Government to alter one locomotive for the purpose of making experiments with it. After one month's service tests were made to compare this compounded engine with a non-compound under exactly similar circumstances, with the result that the former, doing the same work, burned

22 per cent. less fuel (petroleum refuse) than the latter. On account of this favorable showing there were, at the beginning of this year, twelve compound freight locomotives and three compound passenger locomotives in regular service on the Grazi & Tsaritzin Ry., and four more of the former and two of the latter under construction in the shops. The intention is to compound all the locomotives in use on the road as soon as possible. Further tests with these locomotives have shown a fuel saving of at least 18½ per cent., and this, Mr. Urquhart believes, will be increased by better management.

The dimensions of the compound freight locomotives mentioned above are as follows: Cylinders, 18.5 in. and 25.6 in., diam., and 24-in. stroke; slide valve, max. travel, 4¾ ins.; angle of advance of eccentrics, 20°; h. p. valve, outside lap, 0.8 in., inside clearance, 0.08; l. p. valve, outside lap, 0.67 in., no inside clearance. Stephenson link motion. Capacity of receiver, 3.28 cu. ft.; area of receiver surface in smoke box, 11.5 sq. ft. Boiler, working pressure, 135 lbs. Boiler tubes, 151, outside diam., 4.1 in.; length between tube sheets, 13.8 ft.; heating surface, tubes, 1,164 sq. ft.; fire-box, 67 sq. ft.; total, 1,231 sq. ft. Six coupled driving wheels, diam., 4.3 ft. Weight, 36 tons.

The areas of the high-pressure and low-pressure pistons are respectively about 270 and 517 sq. in. The original stroke of 24 ins. and the working boiler pressure of 135 lbs. were not changed. On testing the engine with its original eccentrics, having an angle of advance of 30°, and giving a maximum travel to the valves of 4.5 in., it was shown by the indicator diagrams that there was excessive compression in the high-pressure cylinder and too early a cut-off in both cylinders. The eccentrics now used on all the engines give the valves a travel of 4.7 in., having an angle of advance of 20°. The result of this change has been an improved distribution of the steam, and sufficient power at the third and fourth notches to draw the heaviest trains up the steepest grades encountered on this line (1 to 125). In reality all the locomotives are furnished with screw reversing gear which enables the drivers to use any degree of expansion between mid-gear and full-gear, but the four notches mentioned are used merely for comparison with the ordinary nomenclature when a reversing lever with a sector of four notches is used.

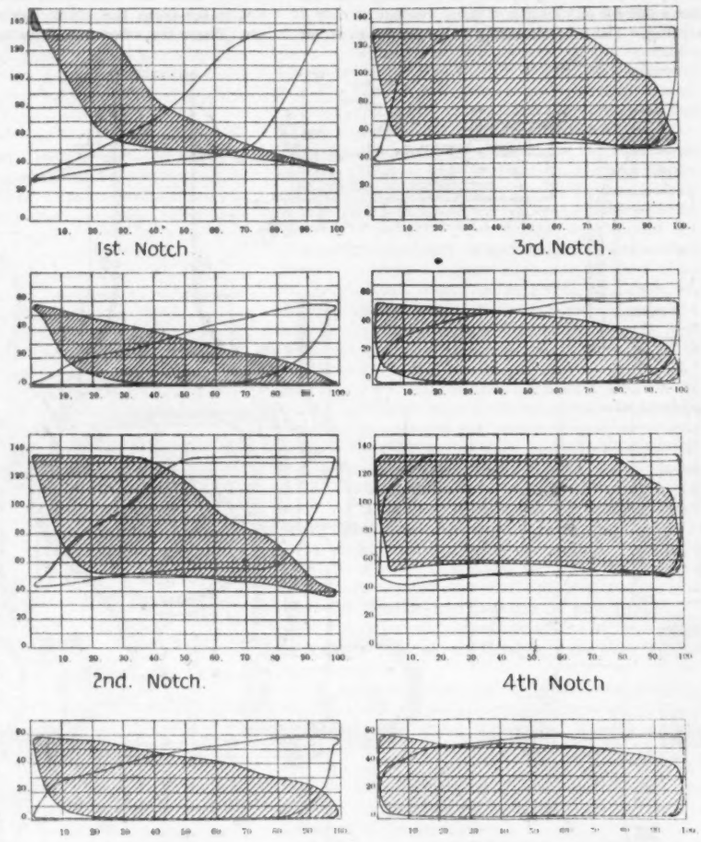


Fig. 4.—Indicator Diagrams of Compound Passenger Locomotive.
(See Table 3.)

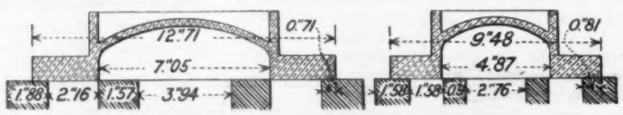


Fig. 5.—Slide Valves, Compound Passenger Locomotive.

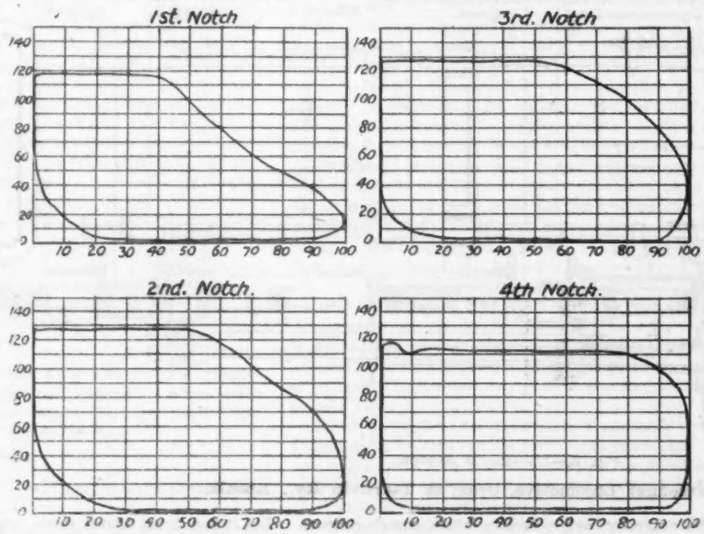


Fig. 6.—Indicator Diagram of Non-Compound Passenger Locomotive.
(See Table 3.)

The tractive power of the 36-ton freight locomotive with six coupled wheels was found to be 5.6 tons or 15.5 per cent. at the third notch. At the fourth notch a tractive power of 6.3 tons, or 18 per cent. of adhesion weight, was attained; which is sufficient to slip the wheels on dry rails.

In the calculation of the tractive power of the compound engine, the power of each cylinder is calculated separately by means of the formula:

$$\text{Tractive power} = 0.57 \times \text{working boiler pressure} \times \left\{ \frac{(\text{Cyl. diam.})^2 \times \text{stroke}}{2 \times \text{diam. of driving wheels.}} \right\}$$

The co-efficient, 0.57, which gives the mean effective pressure on the piston in full gear, must be changed to a lower figure obtained from the indicator diagrams when the degree of expansion is increased. For the low-pressure cylinder, of course, a lower co-efficient must be taken.

An interesting effect of the sequence of cranks was made by Mr. URQUHART in the course of his investigations. The first four engines compounded were arranged with the high-pressure crank leading and the low-pressure following in running forwards. It was accidentally noticed that one of these engines seemed to make steam more readily and develop greater tractive force when running backward, that is, with the low-pressure crank leading. A locomotive was therefore altered to test the effect of the opposite sequence. Indicator diagrams from the engine show that a good distribution results at all notches in the high-pressure cylinder, except the first; while in the low-pressure cylinder the effect is a decided improvement at all notches. Four freight engines now have been altered to make the low-pressure crank the leading one in forward running. The only objection to this arrangement seems to be that too much power is developed in the low-pressure cylinder and too little in the other; but this, Mr. URQUHART thinks, can be remedied by increasing the capacity of the receiver 50 per cent. The first compounded locomotives had a receiver capacity equal to the capacity of the high-pressure cylinder. In the one illustrated the capacity of the receiver is to that of the high-pressure cylinder, as 1.3 is to 1. In one of the newest locomotives this ratio is being further increased to 1.8 to 1 with apparently good effect.

Mr. URQUHART is of the opinion that compound locomotives will eventually be *the* locomotives for all countries, and that the style of locomotive now required is an effective two-cylinder compound with moving parts well-balanced, and as light as possible.

The Nitrate Deposits of Chili.

Consul General JOHN G. WALKER, of Bogota, S. A., makes an interesting report on the nitrate deposits of the Province of Tarapaca, ceded by Peru to Chili, after the war of 1881, as a war indemnity, and subject to redemption after 10 years by the payment of $10,000,000. Under these conditions the deposits will probably remain Chilian property indefinitely, especially as the large accession to the population of Tarapaca, since its annexation, has been from Chili.

The chief deposit of nitrates is in Tarapaca, but the Province of Antofagasta, joining Tarapaca on the south, is also rich in nitrate deposits. The geological belt containing the nitrate is about 200 miles miles long, but its average width is not more than 2½ miles. It stretches along the eastern slope of the barren, verdureless coast range of mountains, upon which rain never falls, and on which there is no vegetation of any description. The average distance from the coast is 14 miles.

As early as 1813 some effort was made to develop these beds, and in that year the Spaniards exported 22,732 quintals of nitrate. But the war of independence breaking out about that time stopped all work until 1852, when GEORGE SMITH and JOSE SANDES founded the Tarapaca Nitrate Co., at Iquique, on a small scale. Encouraged by their success other companies sprang up, until in 1875 the nitrate trade had assumed proportions sufficient to attract the attention of the Peruvian Government to them as a source of national revenue. In that year a law was passed providing for the acquisition of nitrate deposits and refining establishments by the favorite method of "expropriation," and more than sixty establishments of individuals and corporations were thus taken possession of by the Peruvian authorities. Certificates were given in payment to be redeem

through bills of exchange on London, drawn against shipments of nitrate.

The war with Chili occurred before any material part of this indemnity had been paid; but as Peru had fully dispossessed the previous owners, Chili took possession of the mines as Peruvian national property. At the end of the war the outstanding certificates issued by Peru amounted, principal and interest, to $24,276,400. Chili, as heir to the property, was morally bound to satisfy all liens upon it, or to restore it to the former owners. After a few years of unsatisfactory experience in attempting to carry on the works, Chili adopted the latter course, and in July, 1881, ordered the restoration of the appropriated nitrate mines to their original owners, on condition that at least three-fourths of Peruvian certificates were to be delivered to Chili, and a deposit in money made for the missing certificates, to be returned when the latter were delivered.

An immediate and powerful impulse was given to production, and the London nitrate companies and fabulous fortunes suddenly made followed this decision. The London companies are now striving for absolute control, which would mean diminished production to secure higher prices, and a falling off in Chilian revenues from export dues, a danger to which the government is alive. Mr. WALKER explains some of the colossal fortunes already made from these deposits by telling how certain Englishmen, privately informed of the proposed transfer to the original owners, bought up certificates in Lima, for less than half of their face value, covering the very best of the deposits. These parties then transferred their operations to London and in less than six years floated eight stock companies with an aggregate capital of $28,587,750. Mr. WALKER believes that American investment in nitrate property would be favorably regarded by the Chilian Government and people as a wholesome check upon the monopolistic tendencies of the English companies.

The existence in open air of an enormous deposit of a salt so deliquescent as nitrate of soda is only explained by the absolutely rainless nature of that district, extending from 4° S. latitude to about 30° S. latitude, and inland from the Pacific shores an average distance of about 90 miles. The country within these limits is a perfect desert, excepting along the few streams which rising in the snow mountains force their way across the desert to the Pacific.

An examination of the nitrate beds shows that as a rule the surface, for a depth of 8 or 10 ins., is covered by fine loose sand; underneath this sand is found a conglomerate of amorphous porphyry, feldspar, chloride of sodium, magnesia, gypsum, etc., cemented by the sulphate of lime into a hard, compact mass 6 to 10 ft. deep. This is the *costra*, or crust. Below this crust is the *caleche*, or impure nitrate, in a variety of colors. This first nitrate deposit is cemented into a rock-like mass, from 4 to 6 ft. thick, and is quarried by blasting with coarse powder, as dynamite would pulverize it too much.

After being mined, this *caleche* is assorted by experts, broken into pieces about twice the size of an orange and transported to the refineries on the Pampas or on the sea coast, or it is carried to Iquique, Pisagua, Potillos or Antofagasta by railways of narrow gauge. The fuel used in refining is bituminous coal, brought by sea mostly from the coal beds of Southern Chili. Water is obtained by condensing sea water, and for domestic purposes is brought in boats from Arica and other points on the northern sea coast. Artesian wells have never been tried, but Mr. WALKER thinks that the nearness of the snow-clad mountains should encourage experiments.

Mr. GEORGE SMITH, one of the founders of the trade, estimated the amount of crude nitrate in the deposit at 63,000,000 tons; while Mr. BILLINGHURST, in a pamphlet on this subject, puts the total capacity of the nitrate beds at 178,011,000 English tons. A mean between these would furnish an amount sufficient to supply the world, at the present rate of consumption, for many centuries.

The export of the nitrate of soda from five ports of Chili, and mainly from Iquique, for the ten years ending Dec. 31, 1888, was 4,574,440 English tons, valued at $231,411,182 On this export duties were collected, at the rate of "$1 per 100 kilos." (220 lbs.), to the amount of $87,470,622. The export duties on nitrate for 1888 amounted to $17,447,882; and the estimated duties for 1889 was over $19,000,000.

Of the large export of 1888, Germany took 284,000 tons, Holland 33,400, Belgium 84,800, France 156,500 and Great Britain 104,800 tons. The price in the English market ranges from £9 10s to £10, or say $43 to $49 per ton. It is chiefly used in European countries as a fertilizer; but about 30% is consumed in making nitric acid, nitro-glycerine, dynamite, gunpowder, etc. The United States does not figure as an importer of Chilian nitrate, though it might be to the advantage of our agriculturalists and powder makers to turn their attention to its use.

A Compressed Air Hospital.

The hospital of which an illustration is shown herewith is not presented because of the beauty of its architecture or its excessive capacity, inasmuch as an uninstructed person would invariably mistake it for a good-size steam boiler, and it will accommodate at most but four patients.

This capacity, however, is probably quite equal to all the demands that will be made upon it or even that would be made if it were thrown open to the general public, since few sufferers from disease would desire to be placed under 25 or 30 lbs. air pressure, as is proposed to be done with those who enter the portals of this hospital. The object of this structure is a peculiar one. It is for the use of the contractors who are excavating the Hudson River tunnel for the treatment of workmen attacked by the "Bends."

This peculiar disease, familiar to all who have worked with compressed air, is generally believed to be due to coming out too quickly from the compressed air chamber. It resembles in some respects paralysis, or a sudden attack of acute rheumatism, affecting the joints, especially such as may have been strained while at work, and sometimes attacking the region of the heart, in which case it is generally fatal. It has been found that the most effectual remedy for the attack is to send the sufferer back into the caisson immediately, and when he recovers from the attack to bring him out very slowly through the air lock.

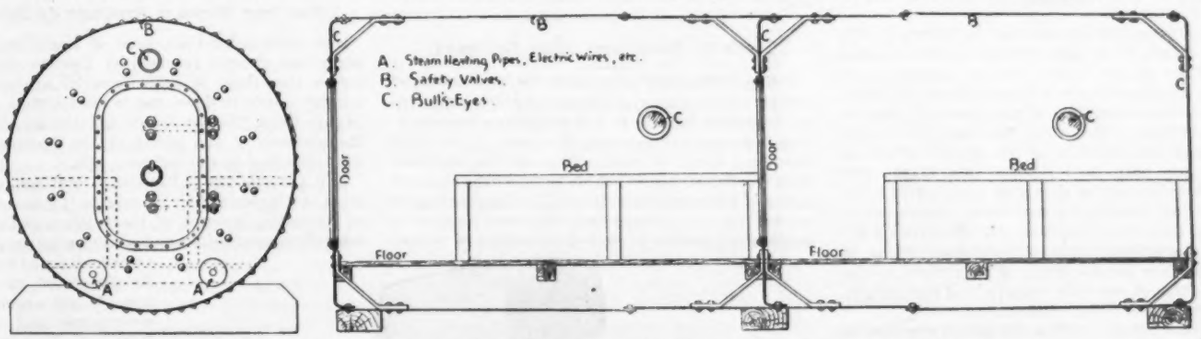
Conveniences are not at hand in the inside of the caisson, however, for the treatment of a patient who may be doubled up like a jackknife with the disease, and it is not always easy to spare the air lock for the slow change of the patient to the outer air which is desirable.

In the work on the Hudson River tunnel, although the air pressure is not very excessive, varying from 28 to 33 lbs., according to the state of the tide, very severe cases of "bends" have occurred. Mr. C. E. MOIR, General Superintendent for S. Pierson & Co., of London, the contractors who are now pushing the tunnel to completion, has therefore devised the chamber herewith illustrated, and it has just been completed at the Cockburn Barrow and Machine Works of Jersey City.

As seen by the engraving, it is simply a cylindrical steel shell, 18 ft. long and 6 ft. in diameter, fitted with proper appliances for receiving and making comfortable the patients. The shell is of ⅝-in. steel and the heads and partition are of ½-in. steel, carefully chipped and calked to hold the air pressure without leakage. The partition is in the center, practically makes one end an air-lock for the other end, so that after the physician has taken a patient in and made him comfortable he can close the partition door and come out. In case all the beds are occupied, the patients whom it is desired to bring out before the others can be taken into the outer compartment.

Each chamber contains two narrow beds with a passageway between them. Beneath the floor are placed steam radiating pipes which pass in through a stuffing box at one end and keep the interior at the proper warmth for the patient. Incandescent lamps are also provided for lighting the interior, and glass bull's eyes permit an attendant on the outside to observe the condition of the patients within.

To furnish fresh air for the inmates, a pet-cock is provided which leaks slightly all the time, and when it is desired to change the patient to the outer air the cock in the pipe leading to the air compressor reservoir is closed, and in two hours or so the interior pressure will have been reduced to the same point as the exterior. Other valves for the escape of air are provided, so arranged that the attendant on the outside can control them, and an impatient patient cannot repeat the rapid exit which was the original cause of his trouble. A safety valve is also attached to the shell, so that in case of a runaway air compressor no harm would result to those confined inside.



End Elevation and Longitudinal Section of Compressed Air Hospital, for Hudson River Tunnel.

The scheme is a humane and commendable one, and Mr. MOIR and the contracting firm which he represents deserve much credit for being the first, to our knowledge, to put this method of relief into operation. The scheme itself is not novel, for as long ago as 1873 ANDREW H. SMITH, M. D., then physician to St. Luke's Hospital, made an elaborate report to the Brooklyn Bridge Directors on the treatment of the caisson disease, as he called it. Dr. SMITH, in 1872, was regularly attached to the staff of the bridge as a physician, and made careful and extended experiments upon the form and treatment of this disease. He found, along with previous investigators, that a return to the caisson was the readiest specific in all serious cases; but as this treatment would often interfere with the regular engineering operations, he suggested a substitute for the lock proper at some easily accessible place above ground.

Dr. SMITH proposed to have a cylinder 9 ft. long and 3½ ft. in diameter, with one end permanently closed and the other provided with an air-tight door. This "lock" was to be lighted by plate glass at both ends and furnished with the proper compressed-air connections. An escape-cock properly regulated was to allow a constant escape of sufficient air to preserve the necessary purity of the atmosphere within. The bed containing the patient was to be slid into this "lock," and the pressure gradually admitted until it nearly or quite equalled that of the caisson, and this pressure continued

until the patient indicated, by a previously arranged signal, that the pain was relieved. As Dr. SMITH resigned his position as physician to the bridge after about four months' experience, his suggestion as to a "hospital lock" was not carried into practice that we know of.

To all interested in the study of this peculiar disease we could recommend the very complete report of Dr. SMITH, and also the very full and interesting memoir of Dr. A. JAMINET, physician to the St. Louis bridge, on "The Physical Effects of Compressed Air."

It has been reported, with seemingly excellent authority, that at the Hudson River tunnel workmen often passed from a pressure of 30 lbs. into the outer air in "30 seconds." We must confess that we cannot conceive this to be possible unless air valves of unusually large area are employed. The danger lies in coming out of the lock; and in the earlier practice, and in much of the present day, the equalizing valves were made of small diameter for the special purpose of preventing a too rapid change from pressure to the normal atmosphere. The old rule was to allow from 12 to 15 minutes for the change when the pressure approached two atmospheres; and while the observance of this rule costs time to the contractor in making a shift, it is questionable whether on purely business principles it is not better to keep the men in good working conditions than to expose them to the dangers of the "bends." But in any case, this hospital idea is a good one, and shows a care for the men in this direction that would indicate a general care in all other directions.

Josiah Meigs and the U. S. Meteorological Bureau.

It is not generally known that in February, 1817, JOSIAH MEIGS, then Commissioner of the General Land Office of the United States, suggested the passage by Congress of a bill authorizing the President to cause meteorological registers to be kept at the Land Offices of the United States and the records to be returned monthly to the General Office at Washington with their reports. Mr. MEIGS proposed that these offices should be provided with the requisite instruments for registering temperature, pressure, rain, wind direction, etc. He strongly advocated the national value of such observations, in affording data for the study of conditions in the various parts of our wide country, and particularly as a study of prevailing wind currents.

Mr. MEIGS failed to obtain the official sanction he sought; but in April, 1817, he sent out circulars to the registers of the land offices, requesting them to make regular and certain meteorological observations, and forwarded blanks to them for this purpose. His request seems to have met with a favorable reception, and for some years the public papers contained notices furnished by him upon "the distribution of caloric" and kindred matters. His returns covered a wide range, and he more than once notices the almost universal prevalence of cold over the country at a certain date; in fact, noting what we now recognize as "a cold wave." For example, he records that "Dec. 21, 1818, was the coldest day between Detroit and Augusta, about 650 miles, or about 9° 20′ of latitude." In 1819, Mr. MEIGS says that "the politeness of the registers" had enabled him to collect observations covering nearly 20 years. He intended to prepare an article upon this subject for the American Philosophical Society, but died before completing it, and his material was presented in 1858 to the American Institute of New York by Mr. HENRY MEIGS.

This JOSIAH MEIGS, as we learn from a memoir published in 1887 by his great-grandson, WM. M MEIGS, was the son of RETURN MEIGS, of Guilford Conn., and the brother of RETURN JONATHAN MEIGS, who was a revolutionary soldier, led one of the attacking columns at the storming of Stony Point, under General WAYNE, and was voted a sword by Congress for his gallantry at Sag Harbor. JOSIAH MEIGS was born in Middletown, Conn., about 1757, and died in Washington in 1822. He graduated at Yale College in 1778, in the same class with NOAH WEBSTER, JOEL BARLOW, OLIVER WALCOTT, JR., URIAH TRACY, ZEPHANIAH SWIFT and others who afterwards achieved fame at home and abroad. After graduation MEIGS was tutor of mathematics, natural philosophy and astronony at Yale from 1781 to 1784; in the latter year he resigned, and established the New Haven *Gazette*, and continued with it until about 1788.

In 1789 Mr. MEIGS went to Bermuda in connection with some law business, and remained there until 1794, when he returned to New York. On Nov. 20, 1794, he was made professor of mathematics and natural philosophy at Yale, and continued at New Haven until November, 1800, when he accepted an appointment as a professor and acting president in the University of Georgia. Owing to some difficulty with the authorities he resigned his position, after some years of service, and in 1812 he was commissioned Surveyor General of the United States by President MADISON. In 1814 he was appointed Commissioner of the General Land Office of the United States, and in this position he remained until his death, in 1822.

Mr. MEIGS was progressive and ahead of his age in many ways. In 1814 he advocated a bridge over the Ohio at Cincinnati, which he thought "an easy job;" he interested himself in 1820 in the founding of a national vaccine institution for the United States; he foretold the growth of the western country, and in 1818 referred to the Atlantic States as simply the "portico to the great political temple of the West;" and he was a constant and bitter foe to slavery, contending that a new Boston or Philadelphia could never be founded in Virginia, Kentucky or Carolina "until they are freed from this deep curse of slavery."

JOSIAH MEIGS was the father of CHARLES D. MEIGS, M. D., long in successful practice in Philadelphia, and a professor of the Jefferson Medical College in that city. Another son was HENRY MEIGS, of New York, a successful lawyer, one time President of the Board of Aldermen, Congressman, etc.

Track for Street and Other Railways.

Owing to the rapid progress in the introduction of electric railways all over this and foreign countries at the present time, it is not surprising that corresponding improvements should be made in the most important detail of track. The old flat rail laid upon wooden stringers, which satisfied the requirements of horse railroads, is rapidly disappearing as the new motive power of electricity with its heavier weights and greater power takes the place of horses.

Fig. 1. Rail with Cast Iron Chair.

The rail now used is almost invariably some form of I or girder rail, and to avoid excessive cutting of the lower flange into the cross ties various forms of wrought and cast iron chairs have been employed to distribute the weight.

Mr. R. T. White, of 12 Pearl St., Boston, has devised the cast-iron chair shown in Fig. 1. It is 4 to 6 ins. high, and the improvement consists in the use of a hollow cast-iron standard, close at the top and giving a broad bearing base. The chairs are said to be both cheaper and stronger than wrought-iron supports, the cost being from 30 to 50 cents each, according to weight required. The rails used with these chairs have all a broad lower flange and are held in place by steel clamps rolled and pressed to fit, manufactured by the American Bolt Co., Lowell, Mass. The weight of rail used varies from 30 to 50 lbs. per yard.

Fig. 2 shows another form of a cheap girder rail for street railways. With these rails, fish-plates accurately fitting between flanges are used, and

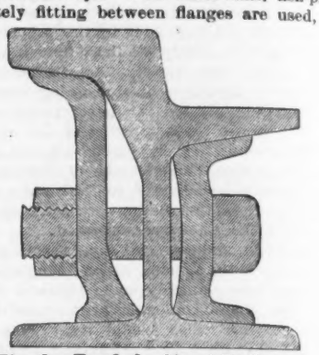


Fig. 2.—Track for Street Railways.

are made slightly bent and drawn to a fit by the bolts. Although these chairs and rails have only been manufactured since Jan. 1, 1890, they have been adopted and are now in use by the North Attleborough and the Wrentham street railway companies, also by the Newton, Waltham, Taunton, Essex Electric, Merrimac Valley, Naumkeag, Augusta, Newburyport, and Amesbury street railways.

The Iron Mines of Santiago de Cuba.

Iron mines richer than those of Spain and more easily and cheaply reached, by Eastern manufacturers, than those of Lake Superior, are only now commencing to be developed in the Province of Santiago de Cuba. Their existence has been known since the conquest of the island by the Spaniards, but they remained unworked until 1881.

U. S. Consul OTTO E. REIMER, of Santiago de Cuba, gives in "Reports of U. S. Consuls," for March, 1890, an interesting account of these mines and the law controlling concessions and mining grants under the Cuban Government. Briefly stated, this new law of 1883 exempts all concessions and grants from ground tax; all minerals and metals may be exported free of duty; all stone- coal imported for use in mining or metallurgic operations is exempt from duty and iron ores and iron mines are free from the 3 per cent. tax on gross product formerly imposed. Machinery used in these industries can be imported free of duty. But vessels entering in ballast and leaving port with iron ore pay navigation and port charges of 5 cts. per ton, and each ton of incoming material or machinery pays $1.30 (Spanish) port charges.

The first attempt to develop these mines was made in 1881 by RUIZ DE LEON; but, though he failed in his operations, it was partly as the result of his effort that, on April 27, 1885, the General Government granted a concession to the Juragua Iron Company (Limited), of Philadelphia, Pa. The ore mined by this company is shipped for the use of the Pennsylvania Iron Co., of Steelton, Pa., and the Bethlehem Iron Co., of Bethlehem, Pa. This concession granted the right to build a narrow-gauge railway from the mines to Santiago de Cuba for the sole use of the mines, and free of all taxes and charges for 99 years.

This company owns 780 hectares, or 312 acres, of

mines, which were bought for $300,000 (Spanish) and a royalty of 5 cents per ton of 2,240 lbs. exported. The company opened, on July 17, 1884, its mining railway, which now has 17 miles of main line, 24 miles of branches and sidings and 1,000 ore cars, 285 small dump cars, 16 flat cars, 2 passenger cars and 8 large and 6 small locomotives. They are working 5 mines in 32 openings, and the estimated expenditure is $2,500,000. Commencing with 23,777 tons in part of 1884, they exported to Nov. 21, 1889, a total of 732,338 tons, the amount for the eleven months of 1889 being 218,556 tons. The company employs 1,200 men in and about the mines. The only difficulty lies in the fact that the transportation facilities are not equal to the demand for this wonderfully rich ore.

These iron deposits may be described as follows: The southern coast of the Province of Santiago de Cuba is mountainous in the extreme, and is traversed parallel with the coast line by the high Sierra Maestra Mountain ridge. This range is partially broken by the Bay of Guantanamo and the Bay of Santiago de Cuba, about 50 miles apart. Between these bays are foot hills running down to the coast, and in these nearly all the mineral is so far found; though lately mineral deposits have been found directly on the coast, and within a few hundred feet of an excellent harbor, on the north coast of the province between Baracoa and Nipe Bay.

The deposits first referred to are divided into nine groups, of which the Juragua mines are in Number 6; the others still await capital and development. The following analysis of the Juragua ore may be taken as a standard for the ore of the whole range:

Constituents.	Per cent.
Silica	1.90
Carbonic acid	0.98
Peroxide of iron	95.65
Alumina	0.55
Lime	0.67
Magnesia	0.15
Manganese oxide	0.50
Sulphur	0.07
Phosphoric acid	0.06
Titanic acid	
Potash	
Organic matter	
Totals	100.53
Metallic iron	66.95

This ore is simply blasted and removed by pick and shovel from the hill side, and is of almost fabulous quantity. Group No. 9, or the Moa, of 185 acres, is not included in the southern ore belt of this province, but lies on the north coast between Mangle Point and Sagua de Tanamo. It is on the shores of a magnificent harbor, and is one day's sail nearer the coast of the United States. It is equally rich with the southern ore, and is wonderfully free from phosphorus and sulphur.

In the latter part of 1889 concessions were granted to JOSE BUENO Y BLANCO for the construction of a mining railway from Baconas to Santiago de Cuba. This road, on which preliminary surveys have already been made by a Spanish government engineer, would benefit the whole range of mines on the southern coast and offers no serious topographical difficulties. The main line would be about 24 miles long. It awaits American capital to go ahead with the proposed work.

Hauling Locomotives Over Country Roads.

At a late meeting of the Engineers' Society of Western Pennsylvania Mr. W. C. QUINCY gave very interesting reminiscences of work on the Baltimore & Ohio R. R. "before and after the war." Mr. QUINCY had charge of the maintenance-of-way department during the war, and had much to say of his stirring experiences about Harper's Ferry in 1861-62.

In referring to the transport of locomotives by the Confederate troops over turnpike roads, Mr. QUINCY quotes an acquaintance who was military railroad superintendent under Gen. JOHNSON. This officer says he hauled 160 box and gondola cars from Winchester to Strasburg, about 16 miles, and 10 locomotives from Martinsburg to Strasburg, and all the machinery in the shops at Martinsburg. He afterwards hauled 3 locomotives and 6 or 8 box-cars 50 miles down the Valley, from Mt. Jackson to Staunton, and thence to Richmond by rail. The turnpikes were good, and the hauling was done with from 20 to 40 horses to an engine, according to its size. Locomotives were precious to the Confederacy in those days.

Statistics of Railway Construction.

SOUTHERN STATES.

(Accompanying Map No. 26 of the Progress and Prospects of Construction).

VIRGINIA.—Existing Roads.

1. ***Atlantic & Danville.***—Track laid in 1889, Danville to North Carolina State line, 4 miles; North Carolina State line to Edgerton, 87.5 miles; Hodges Ferry to Portsmouth, 6 miles; Belfield to Claremont, 5.9 miles. Track laid since Jan. 1, 1890, main line to Buffalo Lithia Springs, 4 miles. Under construction, Belfield south, 8.5 miles. Under survey, Danville to Bristol, Tenn., 175 miles.

Chesapeake & Ohio.—Craig Mineral R. R.—Under construction, Eagle Rock to New Castle, 25 miles. Surveyed, Clifton Forge to Warm Springs, 22 miles.

Cumberland Valley.—Track laid in 1889, Martinsburg to West Virginia State line, 9 miles.

2. ***Farmville & Powhatan.***—Track laid in 1889, Clover Hill to Sunnyside, 34 miles. Track laid since Jan. 1, 1890, Sunnyside to Farmville, 25 miles. Under construction, Farmville to Hampden-Sidney College, 7 miles. Projected, Hampden-Sidney College to Brook Neal, 38 miles.

3. ***Louisville & Nashville.***—Under construction, Cumberland Gap, Tenn., to Big Stone Gap, 71 miles.

4. ***Lynchburg & Durham.***—Track laid in 1889, Rustburg to South Boston, 49 miles. Track laid since Jan. 1, 1890, South Boston, south, 12 miles; Houston to Bannister, 1 mile. Under construction, end of track to Durham, N. C., 32 miles; belt line at Lynchburg, 7 miles. President, Peter J. Otey; Chief Engineer, J. W. Goodwin; both of Lynchburg.

5. ***Norfolk & Western.***—Clinch Valley Division.—Track laid in 1889, end of track to Honaker, 31.3 miles. Track laid since Jan. 1, 1890, Honaker to Bickley's Mills, 19.2 miles. Under construction, Bickley's Mills to Norton, 26.3 miles. New River Division.—Under construction, Great Outburst to North Carolina State line, 21 miles.

6. ***Orange & Keysville.***—Partly graded, Orange to Keysville, 95 miles. Chief Engineer, Thos. Moore, 912 East Main street, Richmond; Contractors, Gamble & Granville, East Saginaw, Mich.

Richmond & Seven Pines.—Track laid in 1889, Richmond to Seven Pines, 8 miles.

Richmond, Fredericksburg & Potomac.—Under construction, connecting link with Richmond & Petersburg R. R. at Richmond, 8 miles. E. T. D. Myers, Richmond

7. ***South Atlantic & Ohio.***—Track laid in 1889, Speer's Ferry to Natural Tunnel, 5.5 miles. Track laid since Jan. 1, 1890, Natural Tunnel to Big Stone Gap, 21 miles. Under construction, Big Stone Gap to Looney Creek, 3 miles; Looney Creek Branch, 2 miles; Pigeon Creek Branch, 2 miles. President, Nathaniel Thayer; Chief Engineer, W. F. Gordon; General Manager, H. W. Bates; all of Bristol, Tenn.

Staunton & West Augusta.—Under contract, Staunton to Dora coal fields, 25 miles. President, R. N. Pool, Staunton.

8. ***Surry, Sussex & Southampton.***—Track laid in 1889, Wakefield to Scotland, 20 miles.

Projects and Surveys.

Fincastle & Troutville.—Under survey, Fincastle to Troutville, 7 miles. President, E. B. Simmons, Fincastle; Chief Engineer, E. Grover, Iron Gate.

Norfolk & Portsmouth Belt.—Surveyed, belt line around cities of Norfolk and Portsmouth, 10 miles.

Ritch Patch Iron Co.—Surveyed, Low Moor to Chesapeake & Ohio R. R., 6 miles. President, D. Shanahan, Louisville, Ky.; Chief Engineer, Carter H. Harrison, Staunton.

9. ***Virginia & Kentucky.***—Projected, Danville to Kentucky State line, 200 miles. President, David S. Pierce, Wytheville; Chief Engineer, J. C. Wrenshall, Danville.

Washington & Western.—Projected, Warrentown to Luray, 50 miles.

Total.—Track laid in 1889, 260.2 miles. Track laid since Jan. 1, 1890, 80.2 miles. In process of construction, 417.8 miles. Surveyed or under survey, 405 miles. Projects of some promise, 292 miles.

NORTH CAROLINA.—Existing Roads.

10. ***Albemarle & Pantego.***—Track laid in 1889, end of track to Pantego, 17 miles; Ropers toward Cresswell, 4 miles. Under construction end of track to Cresswell, 4 miles; end of track to Belle Haven, 2.5 miles. Chief Engineer, H. T. Greenleaf, Elizabeth; General Manager, Geo. W. Roper, Roper.

11. ***Asheville & Bristol.***—Under contract Asheville to Bristol, Tenn., 83 miles. President, Chas. G. Dyott; Chief Engineer, H. M. Ramseur; both of 52 Wall St., New York City.

1. ***Atlantic & Danville.***—Track laid in 1889, Virginia State line south of Danville to Virginia State line near Harmony, 25 miles.

12 ***Atlantic Coast Line.***—Albemarle & Raleigh R. R.—Track laid in 1889, Williamston to Plymouth, 22 miles.—Scotland Neck Extension.—End of track to Greenville, 14 miles. Track laid since Jan. 1, 1890, Greenville south 17 miles. Graded end of track to Kingston, 11 miles. Under survey, Greenville to Washington, 20 miles.—Wilson & Fayetteville R. R.—Under survey, Fayetteville to Rowland, 40 miles.

13. ***Cape Fear & Yadkin Valley.***—Track laid in 1889, Wilmington to Rosboro, 12 miles. Track laid since Jan. 1, 1890, Rosboro to Fayetteville, 20 miles; Millboro to Ramseur, 9.5 miles. Under construction, Mt. Airy to Virginia State line, seven miles; Mt. Airy to Flat Rock, 2 miles.

14. ***Charleston, Cincinnati & Chicago.***—Track laid since Jan 1, 1890, Johnson City, Tenn., north 14 miles. Graded end of track to Minneapolis, Va., 76 miles, Rutherfordton to Marion, 25 miles. Under construction, Johnson City to North Carolina State line, 20 miles. Surveyed, Tennessee State line to Marion, 70 miles; Minneapolis to Ohio River, 160 miles; Johnson City to State Line, 50 miles. Chief Engineer, A. N. Molesworth, Johnson City, Tenn.

15. ***French Broad Valley.***—Under contract, Asheville to South Carolina State line, 60 miles, branch Mills River to Rutherfordton, 40 miles. President, Chas. D. Dyott; Chief Engineer, H. M. Ramseur; both of 52 Wall street, New York City.

16. ***Maxton, Alma & Rowland.***—Track laid in 1889, Plainview to Rowland, 2 miles; Alma to Maxton, 2 miles.

17. ***Norfolk & Carolina.***—Track laid in 1889, Virginia State line to Tunis, 17 miles; Roscobel to Tarboro, 26 miles.

18. ***Ocean View.***—Track laid in 1889, Wilmington to Ocean Beach, 2 miles.

19. ***Richmond & Danville.***—Northwestern North Carolina R. R.—Track laid in 1889, Bathania west 13 miles. Track laid since Jan. 1, 1890, end of track west 33 miles. Under construction, end of track west 10 miles. High Point, Randleman & Asheboro R. R.—Track laid in 1889, High Point to Asheboro, 27 miles. Western North Carolina R. R.—Track laid in 1889, end of toward Murphy, 13 miles. Under construction, end of track to Murphy, 13 miles. North Carolina Midland R. R.—Under construction, Winston to main line, 55 miles. Under survey, Danville, Va. to Winston, 70 miles. Yadkin R. R.—Under construction, Salisbury to Norwood, 42 miles.

20. ***Roanoke & Southern.***—Track laid in 1889, Winston to Dan River, 22 miles. Track laid since Jan. 1, 1890, Walnut Cove to Madison, 15 miles. Graded, Madison to Martinsville, Va., 28 miles. Under construction, Martinsville to Roanoke, Va., 55 miles. Thomasville, Silver Valley & Pee Dee R. R.—Projected, Winston, Salem to Monroe, 85 miles.

21. ***Seaboard Air Line.***—Track laid in 1889, Creedmore to Nuse River, 7 miles.

22. ***Southern & Western Air Line.***—Partly graded, Shelby North, 23 miles. Under contract, end of grade to Linville, 77 miles. President, S. McD. Tate; Chief Engineer, S. W. Wilson, Morganton.

23. ***Suffolk & Carolina.***—Projected Ryland to Edenton, 20 miles.

24. ***Wilmington, Onslow & East Carolina***—Track laid since Jan. 1, 1890, Wilmington east 15 miles. Graded, end of track to Jacksonville, 25 miles. Chief Engineer, F. L. Pittman, Wilmington.

Projects and Surveys.

25. ***Atlanta, Asheville & Baltimore.***—Under survey, Asheville to Roanoke, Va., 200 miles. Projected, Asheville to Atlanta, Ga., 200 miles. President, Natt. Atkinson; Chief Engineer, J. F. Broadley; Secretary, J. E. Rankin; all of Asheville.

26. ***Cabarrus & Stanley.***—Surveyed, Concord to Mt. Pleasant, 9 miles. John P. Allen, Concord.

27. ***Cape Fear & Cincinnati.***—Surveyed, Wilmington to Southport, 25 miles. Projected, to Greenville, S. C., 260 miles. President, Frank Brown; Chief Engineer and Vice-President, George B. Morton, Baltimore, Md.

28. ***Cranberry & Linville.***—Surveyed, Cranberry to Linville, 13 miles. President, Hugh MacRae; Chief Engineer, J. R. Irwin; both of Linville.

29. ***Danville, Mebane, Pittsboro & Southern.***—Projected, Danville to Raleigh & Augusta Air Line R. R., 65 miles.

30. ***Fayetteville & Aberdeen.***—Surveyed, Fayetteville to Raleigh & Augusta Air Line R. R., 45 miles. W. G. McDuffie; Secretary, Z. W. Whitehead; both of Fayetteville.

31. ***Mount Pleasant, Santee & Little River.***—Projected, Charleston, S. C., to Wilmington, 160 miles. President, J. C. McNaughton; Chief Engineer, John Runk; both of 228 Dock St., Philadelphia, Pa.

32. ***Murfreesboro.***—Surveyed, Murfreesboro to Conway, 7 miles. President, B. B. Winborne, Murfreesboro.

Total.—Track laid in 1889, 275 miles. Track laid since Jan. 1, 1890, 111.5 miles. In process of construction, 477.5 miles. Surveyed or under survey, 384 miles. Projects of some promise, 491 miles.

SOUTH CAROLINA.—Existing Roads.

12. ***Atlantic Coast Line.***—Projected, end of track south of Sumter to Augusta, Ga., 85 miles.

33. ***Carolina, Cumberland Gap & Chicago.***—Projected, Edgefield to Asheville, 125 miles.

34. ***Carolina, Knoxville & Western.***—Projected, Augusta, Ga., to Greenville, 115 miles; end of track to Knoxville, 140 miles.

35. ***Charleston & Savannah.***—Projected, Walterborough, north, 13 miles.

14. ***Charleston, Cincinnati & Chicago.***—Under construction, Blacks to Newberry, 70 miles. Projected, Newburry to Augusta, 81 miles.

36. ***Charleston, Sumter & Northern.***—Track laid in 1889, Santee River to Sumter, 33 miles. Track laid since Jan. 1, 1890, Eutawville toward Pine Bluff, 3 miles. Under survey, Sumter to Bennettsville, 65 miles. End of track to Pine Bluff, 3 miles.

37. ***Columbia, Newberry & Laurens.***—Track laid in 1889, Columbia to Broad River, 1 mile. Track laid since Jan. 1, 1890, Broad River to Prosperity, 35 miles. Under construction, Prosperity to Newberry, 7 miles. Chief Engineer, Chas. Ellis, Jr., Columbia.

38. ***Hartsville.***—Track laid in 1889, Floyds to Hartsville, 9.8 miles.

21. ***Seaboard Air Line.***—Georgia, Carolina & Northern R. R.—Track laid since Jan. 1, 1890, Chester to Greenwood, 60 miles. Graded, Greenwood to Savannah River, 30 miles. Under construction, Savannah River to Athens, Ga. 50 miles. Located, Athens to Atlanta, Ga., 60 miles.

39. ***South Bound.***—Under survey, Columbia to Perry, 30 miles; Barnwell to Savannah, Ga., 85 miles. President, Mike Brown, Barnwell; Chief Engineer, Geo. D. Wadley, Savannah.

Projects and Surveys.

40. ***Bennettsville & Society Hill.***—Projected, Bennettsville to Society Hill, 11 miles. Chief Engineer, Thos. R. Lucas, Society Hill.

41. ***Atlantic, Asheville & Knoxville.***—Surveyed Chester to Gaffney City, 40 miles. President, J. O. Sargeant; Vice-President, John W. Wilkes; both of Chester, S. C.

42. ***Carolina southern.***—Surveyed, Cheraw to Sumter, 65 miles. President, W. G. Childs, Columbia; Chief Engineer, Wm. Moncure, Durham.

43. ***Mount Pleasant & Seaview City.***—Surveyed, Charleston to Seaview City, 7 miles. President, J. P. Kennerly, Charleston.

44. ***Walterboro & Yemassee.***—Surveyed, Yemassee to Pregnalls, 10 miles. President, R. C. Barkley, Charleston; Chief Engineer, Gordon Gairdner, Augusta, Ga.

Total.—Track laid in 1889, 43.8 miles. Track laid since Jan. 1, 1890, 98 miles. In process of construction, 110 miles. Surveyed or under survey, 294 miles. Projects of some promise, 830 miles.

GEORGIA.—Existing Roads.

45. ***Abbeville & Way Cross.***—Under construction, Abbeville to Swan, 25 miles. Under survey, Swan to Way

Cross, 69 miles. Projected, Abbeville to Unadilla, 45 miles. President, J. D. Maynard; Chief Engineer, F. C. Hand; both of Abbeville.

46. *Alabama Midland.*—Track laid in 1889, Bainbridge to Alabama State line, 35 miles.

47. *Atlanta & West Point.*—Track laid in 1889, Atlanta to East Point 6 miles.

48. *Augusta & Florida.*—Under construction, Augusta south, 10 miles. Projected, end of track to Thomasville, 220 miles. President, C. E. Smith, 3 Warren Block, Augusta.

49. *Central Railroad of Georgia.*—Savannah & Western R. R.—Track laid in 1889, Eden to Pembroke, 15 miles. Track laid since Jan. 1, 1890, Pembroke to Lyons, 50 miles.—Buena Vista & Ellaville R. R.—Track laid in 1889, Upatoi Creek to Buena Vista, 26.5 miles.

50. *Chattanooga, Rome & Columbus.*—Projected, Carrollton to Columbus, 101 miles.

51. *Chattanooga Southern.*—Track laid since Jan. 1, 1890, Tennessee State line to Alabama State line, 25 miles. Under construction, Georgia State line to Gadsden, Ala., 55 miles.

52. *Columbus Southern.*—Track laid in 1889, Columbus to Weston, 40 miles. Track laid since Jan. 1, 1890, Weston to Albany, 33.68 miles.

53. *Dover & Statesboro.*—Track laid in 1889, Dover to Statesboro, 10 miles. Projected, Statesboro to Way Cross, 90 miles. President, Fred Lockhart; Chief Engineer, Gordon Gairdner; both of Augusta.

54. *East Tennessee, Virginia & Georgia.*—Under construction, Hazlehurst to Way Cross, 40 miles.

55. *Empire & Dublin.*—Track laid in 1889, Hawkinsville toward Dublin, 32 miles. Under survey, Hawkinsville to Grovania, 13 miles.

56. *Georgia Midland & Gulf.*—Projected, McDonough to Athens, 98 miles.

57. *Georgia, Southern & Florida.*—Track laid in 1889, 150 mile post to Florida State line, 20 miles. Located, Tifton to Thomasville, 55 miles. Macon & Birmingham R. R.—Track laid since January 1, 1890, Macon Junction west, 20 miles. Under construction, end of track to La Grange, 75 miles. Under Survey, La Grange to Birmingham, 135 miles. Macon & Atlantic R. R.—Macon to Savannah, 160 miles.

58. *Knoxville Southern.*—Track laid in 1889, Blue Ridge to Tennessee State line, 10 miles.

59. *Lexington Terminal.*—Track laid in 1889, Crawford to Lexington, 3.5 miles.

60. *Macon & Dublin.*—Partly graded, Macon to Dublin, 55 miles. President, Dudley Hughes, Macon.

61. *Middle Georgia & Atlantic.*—Track laid since Jan. 1, 1890, Machen to Eatonton, 18 miles. Under construction, Machen to Covington, 20 miles. Surveyed, Savannah to Eatonton, 170 miles. Chief Engineer, L. W. Robert, Monticello.

62. *Midville, Swainsboro & Red Bluff.*—Track laid in 1889, Midville to Swainsboro, 20 miles.

63. *Millen & Southern.*—Track laid in 1889, Rogers to Stillmore, 32 miles. Projected, Stillmore to Sterling, 48.75 miles. President, Loring Miller, 16 Beaver St., New York city.

64. *Savannah, Americus & Montgomery.*—Track laid in 1889, Abbeville to Oconee river, 45 miles. Track laid since Jan. 1, 1890, Oconee river to Lyons, 20 miles.

65. *South Brunswick Terminal.*—Track laid in 1889, South Brunswick to Waynesville, 18 miles. Projected, Waynesville to Cordele, 160 miles. President, John I. Holly, New York city. Chief Engineer, J. F. Degnow, Brunswick.

66. *Union Point & White Plains.*—Track laid in 1889, Union Point to White Plains, 12 miles. Projected, White Plains to Tennille, 34 miles.

67. *Way Cross Air Line.*—Track laid since Jan. 1 1890, Way Cross west, 24 miles. Under construction, end of track west, 5 miles. Under survey, end of track to Cordele, 78 miles. President, Loring B. Miller, 16 Beaver St., New York City; Chief Engineer, J. T. Stone, Cordele; Vice-President and General Manager, L. Johnson, Way Cross.

68. *Wrightville & Tennille.*—Projected, Dublin to Abbeville, 48 miles. President, W. B. Thomas, Abbeville.

Projects and Surveys.

69. *Alabama, Georgia & Florida.*—Projected, Richlands to Quincy, Fla., 110 miles. Chief Engineer, W. S. Green, Columbus.

70. *Albany, Florida & Northern.*—Surveyed, Albany to Cordele, 40 miles. President, Nelson Tift, Albany.

71. *Atlanta & Alabama.*—Projected, Atlanta to Selma, Ala., 175 miles. L. E. O'Keefe, 69 Forest Ave., Atlanta.

72. *Atlanta, Atlantic & Great Western.*—Surveyed, Atlanta to Savannah, 270 miles. President, Geo. T. Frey; Chief Engineer, W. T. B. Wilson, both of Atlanta.

73. *Bellton, Homer & Carnesville.*—Projected, Bellton to Carnesville, 25 miles. President, M. Buice, Covington; Vice-President, L. N. Tribble, Carnesville.

74. *Dahlonega & Dawsonville.*—Projected, Tate to Lula Junction, 55 miles. President, Chas. H. James, 264 Jones St., Atlanta; Chief Engineer, Frank W. Hall, Dahlonega.

75. *Danielsville.*—Projected. Danielsville to Georgia, Carolina & Northern R. R., 8 miles. Dr. Geo Daniels, Danielsville.

76. *Etowah Valley.*—Projected. Gainesville to Kingston, 75 miles. Chief Engineer, P. B. Lawrence, 90 Ellis St., Atlanta.

77. *Florida, Dawson & Northern.*—Projected, Dawson to Tallahassee, Fla., 100 miles. President, R. L. Bennett; Secretary, B. H. Hood; both of Dawson.

78. *Florida Midland & Gulf.*—Under survey, Valdosta to Deadman's Bay, 90 miles. Chief Engineer Arthur Pou, Valdosta; W. B. Thomas, Tennille.

79. *Georgia, Tennessee & Illinois.*—Surveyed, Tallapoosa to Cave Springs, 34 miles. Projected, Cave Springs to Chattanooga, 65 miles. President, W. B. Strong, Tennille, Chief Engineer, L. F. Bellinger, Tallapoosa.

80. *Rome Mineral.*—Projected, Rome to Ringgold, 65 miles.

81. *Talbotton & Western.*—Under survey, Waverly Hall to Flint River, 30 miles. W. H. Martin, Talbotton.

Total.—Track laid in 1889, 325 miles. Track laid since Jan. 1, 1890, 196.68 miles. In process of construction, 278 miles. Surveyed or under survey, 1,091 miles. Projects of some promise, 1,487.75 miles.

FLORIDA.—Existing Roads.

82. *Apopka, Clay Springs & Gulf.*—Track laid in 1889, Clay Springs to Apopka, 5 miles.

83. *Atlantic, Gulf & Havana.*—Under construction, St. Augustine to New Smyrna, 65 miles. President, John D. Stetson, Philadelphia, Pa.; Chief Engineer, D. D. Rogers, Daytonia.

84. *Augusta, Tallahassee & Gulf.*—Under survey, Tallahassee to Apalachicola, 55 miles. Contractors, R. P. McCormick, Kansas City, Mo.

85. *Florida Central & Peninsular.*—Track laid since Jan. 1, 1890, Tampa to Plant City, 22.5 miles.

86. *Florida Midland.*—Partly graded, Harper's to Kissemmee, 12 miles.

87. *Georgia, Southern & Florida.*—Track laid in 1889, Georgia State line to mile post 282, 62 miles; Palatka to mile post 266, 20 miles, Track laid since January 1, 1890, mile post 232 to mile post 266, 34 miles.

87. *Jacksonville, Tampa & Key West.*—Jupiter & Lake Worth Ry.—Track laid in 1889, Jupiter to Lake Worth, 7.6 miles.

88. *Orange Belt.*—Track laid in 1889, Monroe to Sanford, 4 miles.

89. *Orlando & Lake Jessup.*—Track laid since Jan. 1, 1890 Lakemont to Gabriella, 5 miles. Under construction, Gabriella to Lake Jessup, 5 miles. Chief Engineer, J. H. Abbott, Orlando.

90. *Palatka & Anclote.*—Under construction, Palatka south 10 miles. Projected, end of grade to Anclote, 115 miles.

91. *St. Augustine & South Beach.*—Track laid in 1889, Junction to Station 54, 1 mile.

92. *St. Cloud Sugar Belt.*—Track laid in 1889, Runnymede to Narcosse, 3.64 miles.

93. *Suwanee River.*—Track laid in 1889, Flagler Junction southwest, 5.5 miles. Track laid since Jan. 1, 1890, end of track to Hattyburg, 12 miles.

94. *Tavares & Gulf.*—Projected, Clermont to Punta Gorda, 175 miles.

95. *Tobacco Belt.*—Track laid in 1889, West Farm to Belleville, 9 miles.

96. *Western Railway of Florida.*—Track laid in 1889, Belmore to Melrose, 19 miles.

97. *West Florida & Alabama.*—Under construction, Chipley to St. Andrew's Bay, 40 miles. Projected, St. Andrew's Bay to St. Joseph, 60 miles; St. Andrew's Bay to Appalachicola, 60 miles; Eufaula, Ala., to Chipley, 80 miles. President, J. D. Perrong, Wewahitchka.

Projects and Surveys.

98. *Midland Transit.*—Projected, Rochelle to Montrose, 17 miles. Robert W. Davis, Alachua.

99. *Monticello & Tampa.*—Projected, Monticello to Tampa, 225 miles. Jas. S. Denham, J. H. Perkins, both of Monticello.

100. *Palatka & Lake Shore.*—Projected, Apopka to Palatka, 80 miles. President, A. Dresden. Chief Engineer, E. B. Patton, Windermere.

101. *St. Johns & De Land.*—Located, De Land to Beresford, 4 miles. Chief Engineer, D. D. Rogers, Ocala.

102. *Tampa, Tallahassee & Western.*—Projected, Tampa to Tallahassee, 270 miles, with branches to Gainesville, Lake Butler and Ocala, 85 miles. President, N. F. Dutton, Gainesville. Chief Engineer, D. D. Rogers, Ocala.

Total.—Track laid in 1889, 136.74 miles. Track laid since Jan. 1, 1890, 73.5 miles. In process of construction, 132 miles. Surveyed or under survey, 140 miles. Projects of some promise, 1,132 miles.

ALABAMA.—Existing Roads.

46. *Alabama Midland.*—Track laid in 1889, Georgia state line to Troy, 72 miles; Ada south 10 miles. Track laid since Jan. 1, 1890, Troy to end of track, 23 miles—Montgomery, Tuscaloosa & Memphis, R. R.: Under construction, Montgomery to Tuscaloosa, 106 miles.

103. *Birmingham, Sheffield & Tennessee River.*—Track laid since Jan. 1, 1890, Jasper to Georgia Pacific R. R., 95 miles. Under construction, Margerum to Riverton, 11 miles. Surveyed, South Parish to Warrior River, 20 miles.

104. *Blue Mountain Mineral.*—Under construction, Anniston to East & West Ry. of Alabama, 20 miles. J. C. Gaboury, Jacksonville.

49. *Central Railroad of Georgia.*—Track laid in 1889, Chattahoochee River to Columbia, 1.03 miles.

105. *Cincinnati, Selma & Mobile.*—Projected, Marion to Selma, 25 miles; Akron to Aberdeen, Miss., 80 miles.

106. *Dauphin Island.*—Partly graded, Mobile to Dauphin Island, 36 miles. Chief Engineer, F. K. G. Wright, Venetia.

107. *Dayton & Faunsdale.*—Graded, Dayton to Faunsdale, 8.5 miles. President, R. W. Price, Dayton.

108. *Decatur, Chesapeake & New Orleans.*—Surveyed, Tennessee State line to Decatur, 30 miles. For officers, see Tennessee.

109 *East & West Ry. of Alabama.*—Projected, Rayland to Birmingham, 35 miles.

54. *East Tennessee, Virginia & Georgia.*—Briarfield, Blocton & Birmingham R. R.—Track laid in 1889, Birmingham Junction to Savage Creek, 19 miles. Track laid since Jan. 1, 1890, Savage Creek to Blocton, 12 miles. Under construction, Savage Creek to Bessemer, 20 miles. Rome & Decatur: Projected, Attala to Decatur, Ala., 70 miles.

110. *Florence Northern.*—Partly graded, Florence north, 25 miles. Located, end of grade to Linden, Tenn., 51 miles. President, W. B. Wood; Chief Engineer, A. G. Negley; both of Florence, Ala.

111. *Georgia Pacific.*—Track laid in 1889, Henryellen to mines, 2 miles.

112. *Guntersville, Ft. Payne & Chattooga Valley.*—Track laid since Jan. 1, 1890, Ft. Payne to end of track, 8 miles Partly graded, end of track west, 10 miles. Projected, end of grade west, 20 miles; Ft. Payne to Rome, Ga., 37 miles. President, L. A. Dobbs; Secretary, Henry B. Campbell, Ft. Payne.

113. *Huntsville Belt & Monte Sano.*—Track laid in 1889, end of track to Monte Sano, 4.5 miles.

3. *Louisville & Nashville.*—Birmingham Mineral R. R.—Track laid in 1889, Red Gap Branch, 10.25 miles; Dudley Branch, 2.8 miles.—Nashville, Florence & Sheffield R. R.—Wrigot & Keeley ore spur, 1.5 miles. Track laid since Jan. 1, 1890, Red Gap to Graces, 10.09 miles; Boyles to Birmingham, 2.09 miles.—Tuscaloosa Branch.—Under construction, Milldale to Standard Coal Co.'s mines, 5 miles. Projected, mines to Tuscaloosa, 15 miles. Under construction, Helena to Gurnee, 10 miles.—Anniston & Cincinnati R. R.—Under survey, Sylacauga to Longview, 35 miles. Projected, Pine Apple to Repton, 35 miles.

114. *Mary Lee Coal & Ry. Co.*—Track laid in 1889, Birmingham to Lewisburg, 6 miles.

115. *Nashville, Chattanooga & St. Louis.*—Projected, Attala to Huntsville, 85 miles.

116. *Ohatchee Valley.*—Track laid in 1889, Oak Grove to Griffin, 5 miles.

117. *Piedmont, Laney & Birmingham.*—Track laid in 1889, Laney to Piedmont, 2 miles. Under construction, end of track to Piedmont, 18 miles. Chief Engineer, P. S. Fitzgerald, Gadsden; J. C. Laney, Laney.

118. *Rutledge & Julian.*—Surveyed, Rutledge to Julian, 3 miles. President, B. A. Walker, Rutledge.

64. *Savannah, Americus & Montgomery.*—Under construction, Louvale to Montgomery, 96 miles.

119. *Talladaga & Coosa Valley.*—Track laid in 1889, Ragan to Ragan Junction, 1.5 miles; Murphy to Talladaga, 2.5 miles. Projected, Renfroe to ore beds, 7 miles.

Projects and Surveys.

120. *Anniston & Montgomery.*—Projected, Anniston to Montgomery, Ala., 110 miles. President, John W. Noble. Chief Engineer, C. C. Wrenshall; both of Anniston.

121. *Birmingham & Shade Mt.*—Projected, Birmingham to Hale Springs, 10 miles. President, D. P. Hale, Oxmoor.

122. *Bridgeport Southern.*—Projected, Bridgeport to Guntersville, 55 miles. J. B. Haraison, Langston; J. E. Brown, Scottsboro.

123. *Chattanooga, Gadsden & Birmingham.*—Projected, Gadsden to Leeds, 47 miles. General Manager, J. C. Henderson, Chattanooga, Tenn.

124. *Columbia, Geneva & Western.*—Projected, Columbia to Geneva, 50 miles. John T. Davis, A. D. Wood, both of Columbia.

125. *Greenville & Southeastern.*—Surveyed, Greenville to Elba, 51 miles. President, D. G. Dunklin; Secretary, A. Steinhart; both of Greenville.

126. *Gulf & Chicago.*—Under survey, Mobile to Sheffield, 300 miles. President, C. C. Merrick, 15 Union Building, Chicago, Ill; Secretary, W. S. Lewis, 38 St. Francis street, Mobile.

127. *Gurley & Paint Rock Valley.*—Surveyed, Winchester, Tenn., to Guntersville, 65 miles. President, F. B. Gurley; E. T. Walker; both of Gurley.

128. *Piedmont Southern.*—Projected, Gadsden to Roanoke, 75 miles. B. F. Johnson, Anniston; D. W. Taylor, Wilmington, N. C.

129. *Selma & Bessemer.*—Projected, Selma to Bessemer, 80 miles. A. W. Thorn, R. M. Nelson, both of Selma.

Total.—Track laid in 1889, 140.08 miles. Track laid since Jan. 1, 1890, 64.68 miles. In process of construction, 648 miles. Projects of some promise, 1,511 miles.

MISSISSIPPI.—Existing Roads.

112. *Georgia Pacific.*—Track laid in 1889, point west of Columbus west, 103 miles. Track laid since Jan. 1, 1890, Itta Bena to Hopson's Bayou, 35 miles. Surveyed, Hopson's Bayou to Helena, Ark., 45 miles; Itta Bena to Yazoo City, 45 miles.

130. *Gulf & Ship Island.*—Track laid in 1889, Bayou Bernard north, 5 miles. Projected, end of track to Hattersburg, 54 miles.

131. *Kansas City, Memphis & Birmingham.*—Projected, Aberdeen to Columbus, 28 miles.

132. *Louisville, New Orleans & Texas.*—Track laid in 1889, Riverside Junction to Hampton, 10.2 miles. Coahoma to Rosedale, 50.3 miles. Track laid since Jan. 1, 1890, Clarksdale north, 8 miles. Graded, end of track to Minter City, 37 miles. Located, Minter City to Yazoo City, 65 miles.

133. *Memphis & Atlantic.*—Under construction, West Point to Houston, 30 miles. Surveyed, Houston to Memphis, Tenn., 115 miles. President, F. M. Abbott; Chief Engineer, Belton Mickle, both of West Point.

134. *Poplar Springs Handly's Lake & Meridian Dummy.*—Surveyed, Meridian to Poplar Springs, 2 miles. President, W. B. Brown; Chief Engineer, M. U. Brandon, both of Meridian.

Projects and Surveys.

135. *Helena, Tupelo & Decatur.*—Projected, Tupelo to Decatur, Ala., 100 miles. Secretary, Harvey C. Medford, Tupelo.

136. *Meridian & Tuscahoma.*—Projected, Meridian to Tuscahoma, Ala., 45.7 miles, President, W. H. Hardy, Meridian.

137. *Mobile, Jackson & Kansas City.*—Surveyed, Mobile to Brandon, 176 miles. President, F. A. Luling; Chief Engineer, T. W. Nicol; both of Mobile, Ala.

138. *South Mississippi.*—Projected, Natchez to Meridian, 180 miles. Chief Engineer, Maj. Belton Mickle, Holly Springs.

139. *Waynesboro, Pascagoula & Gulf Coast.*—Projected, Waynesboro to Pascagoula, 107 miles. President, J. R. S. Pitts, Waynesboro.

Total.—Track laid in 1889, 158.5 miles. Track laid since Jan. 1, 1890, 43 miles. In process of construction, 67 miles. Surveyed or under survey, 597 miles. Projects of some promise, 454.7 miles.

TENNESSEE.—Existing Roads.

51. *Chattanooga Southern.*—Track laid in 1889, Georgia State line to Brenaham, 3 miles.

140. *Chattanooga Union.*—Track laid in 1889, Tinkers to Sherman Heights, 1.5 miles; Oak to Thurmans, 2 miles.

141 *Chesapeake & Nashville.*—Projected, Gallatin to Nashville, 26 miles.

142. *Cincinnati, Alabama & Atlantic.*—Partly graded, Huntsville, Ala., to Tullahoma, 55 miles. Projected, Tullahoma to Somerset, Ky., 160 miles. President, M. P. Campbell; Chief Engineer, O. H. P. Cornell; both of Tullahoma.

103. *Decatur, Chesapeake & New Orleans.*—Track laid in 1889, Booneville to the Alabama State line, 34 miles. Surveyed, Booneville to Gallatin, 80 miles. President, G. C. Sandusky, Shelbyville; Chief Engineer, C. H. Roser, Fayetteville.

54. *East Tennessee, Virginia & Georgia.*—Johnson City & Carolina R. R.—Under construction, Johnson City to Embreville, 10 miles. Contractors, Purdy & Rexford, New York City.

143. *Genesis & Obed River.*—Track laid in 1889, Genesis to Obed River, 2 miles. Surveyed, end of track to Bon Air, 26 miles.

Harriman Belt.—Track laid since Jan. 1, 1890, on belt line at Harriman, Tenn., 1 mile. Under construction belt line, 3 miles. Chief Engineer, J. P. Suverkrop, W. H. Russell; both of Harriman.

144. ***Knoxville & Northeastern.***— Surveyed, Knoxville to Dandridge, 30 miles. Chief Engineer, W. A. Park; Robert Pritchard; both of Knoxville.

145. ***Knoxville, Cumberland Gap & Louisville.***—Track laid in 1889, end of track to Cumberland Gap, 53 miles.

58. ***Knoxville Southern.***—Track laid in 1889, Georgia State line to Hiawassee River, 15 miles; end of track 8 miles south of Nashville & Tellico R. R. to end of track 6 miles north of N. & T. R. R., 14 miles. Track laid since Jan. 1, 1890, Hiawassee River to end track, 15 miles; end of track north, 30 miles. Under construction, end of track to Knoxville, 10 miles.

3. ***Louisville & Nashville.***—Under survey, Summertown to Waynesborough, 36 miles; Jellico to Bird's Eye coal fields, 6 miles; Saxton to Bird's Eye coal field, 5 miles; Clarksville to Dickson, 35 miles.

146. ***Morristown & Cumberland Gap.***—Under contract, Morristown to Cumberland Gap, 30 miles. Contractors, Allison, Shafer & Co., Chattanooga.

147. ***Nashville & Knoxville.***—Track laid in 1889, Carthage to Buffalo Valley, 16 miles. Track laid since Jan. 1, 1890, Caney Fork to Cookeville, 22 miles. Projected, Cookeville to Glen Alice, 55 miles; Standing Stone to Hanging Limb, 15 miles. President, A. J. Crawford, Chief Engineer, A. B. Fitch, both of Terre Haute, Ind.

148. ***Nashville, Chattanooga & St. Louis*** —Located, Dunlap to Pikeville, 18 miles.

149. ***Ohio Valley.***—Nashville Northern R. R. Projected, Princeton, Ky., to Nashville, 100 miles.

150. ***Paint Rock Coal & Coke Co.***—Under construction, Oneida to mines, 45 miles. President, H. S. Green, St. Louis, Mo. Chief Engineer, Harry Bosler, Oneida.

151. ***Raleigh Springs.***—Under construction, Memphis to Raleigh Springs, 11 miles. President, John Farguson; General Manager, E. Scott; both of Memphis.

152. ***Tennessee & Ohio.***—Projected, Rogersville to Big Stone Gap, 45 miles. President, E. J. Sanford, Knoxville.

153 ***Tennessee Midland.***—Track laid in 1889, Van Osdells to Perryville, 38 miles. Under construction, Perryville to Nashville, 92 miles. Surveyed Nashville to Virginia State line, 288 miles.

Projects and Surveys.

154 ***Birmingham, Jackson & Kansas City.***—Under survey, Jackson to Fowlks, 45 miles. President, Clifton Dancy, Chief Engineer, J. J. Williams, both of Jackson; Robert Gates, Memphis.

155. ***Bristol, Elizabethtown & North Carolina.***—Under survey, Bristol to Mountain City, 75 miles. President, W. D. Haynes; Chief Engineer, Geo. S. Bruce; A. D. Reynolds, all of Bristol.

156. ***Chattanooga, Cleveland & Murphy.***—Projected, Cleveland to Murphy, N. C., 70 miles. President, E. Watkins, Chattanooga.

157. ***Coal Creek & Beech Fork.***—Projected, Coal Creek to New River, 35 miles. President, T. H. Heald, Knoxville.

158. ***Cumberland Mt. and Tennessee River.***—Projected, Bridgport, Ala., to Lansing, 100 miles. J. W. Hudson, Bridgeport.

159. ***Missouri, Tennessee and Georgia.***—Under construction, Hickman, Ky., to Humboldt, 85 miles. President, L. B. Wright, Humboldt; Chief Engineer, J. J. Williams, Jackson.

160. ***Southern Coal, Iron and R'y Co.***—Projected, Asheville, N. C., to Athens, 125 miles. Chilhowee to Maryville, 15 miles; Chilhowee to Morristown, 60 miles.

161. ***Tennessee, Alabama, Land, Mining & Ry. Co.***—Projected, Winchester to Bellefonte, Ala., 62 miles. President, M. H. Lake, Stephenson, Ala., J. L. Girten, Winchester.

162. ***Tennessee & Alabama.***—Projected, Huntington to Dyersburg, 60 miles. N. Scott, Louisville.

163. ***Union City, Louisville & Memphis.***—Projected, loop line connecting Union City, Tenn., with the Newport News & Mississippi Valley R. R., 15 miles. President, W. H. Gardner, Union City.

164. ***Watauga Valley.***—Surveyed, Johnson City to Atlantic & Danville R. R., 50 miles. A. D. Reynolds, Bristol.

Total.—Track laid in 1889, 178.5 miles. Track laid since Jan. 1, 1890, 82 miles. In process of construction, 386.5 miles. Surveyed or under survey, 822 miles. Projects of some promise, 738 miles.

KENTUCKY.—Existing Roads.

Covington Transfer.—Partly graded, Covington to Ludlow, 2 miles.

Eastern Kentucky.—Track laid in 1889. Willard to Webville, 2 miles.

Kentucky Midland.—Track laid in 1889. Frankfort to Paris, 40 miles. Projected, Paris to Big Sandy Valley, 150 miles.

Kentucky Union.—Track laid in 1889. Dodge to Winchester, 6.75 miles; Clay City to Kentucky River, 30 miles. Track laid since Jan. 1, 1890, Winchester to Lexington, 20 miles. Under construction, Kentucky River to Lost Creek, 28 miles.

Kinnickinnick.—Under construction, Kinnickinnick to Quarries, 8 miles.

Lexington Belt.—Track laid, since Jan. 1, 1890, at Lexington, 5 miles. Under construction at Lexington, 3 miles. President, Charles H. Stoll; Chief Engineer, A. I. Totten, both of Lexington.

3. ***Louisville & Nashville.***—Track laid in 1889, Pineville to Cumberland Gap, 14.7 miles.

Louisville, St. Louis & Texas.—Track laid in 1889, Irvington west, 20 miles. Track laid since Jan. 1, 1890, Hardensburg to Fordsville, 13 miles; branch to Falls of Rough, 4.5 miles.

Louisville Southern.—Track laid in 1889, Lawrenceburgh to Lexington, 24 miles. Richmond, Nicholasville, Irvine and Beattyville R. R.—Track laid since Jan. 1, 1890, Versailles south, 10 miles. Under construction end of track, to Beattyville, 85 miles. Projected, Beattyville to Virginia State line, 85 miles.

Middlesborough Belt.—Under construction, belt line at Middleborough, Ky., 42 miles; under survey, Bennett's Fork Branch, 5.5 miles; Stoney Fork Branch, 6 miles.

Ohio & Big Sandy.—Surveyed, Richardson to Pocahontas, Va., 80 miles.

Ohio Valley.—Track laid in 1889, Indiana State line to Henderson, 7.3 miles.

Owensboro, Falls of Rough & Green River.—Track laid in 1889, Owensboro to Fordville, 28 miles. Under construction, Fordsvills to Falls of Rough, 10 miles.

165. ***Paducah, Tennessee & Alabama.***—Under construction, Paducah to Paris, Tenn., 65 miles.

Passenger & Belt.—Track laid in 1889, at Lexington Ky., 2.5 miles.

166 ***West Virginia, Pineville & Tennessee.***—Under construction, Pineville, east 10 miles. Projected 10-mile post to Breaks of Sandy, 130 miles. President, H. V. Loving, Pineville.

Projects and Surveys.

167. ***Bowling Green & Northern.***—Surveyed, Bowling green to the Chesapeake & Ohio Southern R. R., 40 miles. Secretary, M. H. Crump, Bowling Green.

168. ***Burkesville & Northwestern.***—Surveyed, Burkesville to Horse Cave, 46 miles. President, W. F. Alexander; Chief Engineer, H. A. Genung; both of Burkesville.

Covington & Louisville.—Under survey, Covington to Louisville, 100 miles. John S. Gaunt, Carrollton.

Danville.—Projected, Danville to Alum Springs, 5 miles. President, W. L. Caldwell; John W. Yerkes, both of Danville.

169. ***Henderson State Line.***—Projected, Henderson to Bowling Green, 100 miles. President, S. K. Surrell, Henderson.

Lexington & Richmond.—Projected, Lexington to Richmond, 26 miles. President, C. J. Bronston, Secretary, James C. Rogers; Lexington.

Mount Sterling.—Projected, Mount Sterling to North Middleton, 10 miles. M. S. Tyler, Mt. Sterling.

170. ***Paducah & Hickman.***—Projected, Paducah to Hickman, Ky., 50 miles. Secretary, W. F. Paxton, Paducah.

Total.—Track laid in 1889, 175.25 miles. Track laid since Jan. 1, 1890, 52.5 miles. In process of construction, 213 miles. Surveyed or under survey, 247.5 miles. Projects of some promise, 651 miles.

An Experimental Study of Air Resistance.*

BY O. T. CROSBY.

(*Continued from Page* 531.)

The linear velocity of the car was known by count of revolutions per second multiplied by length of circumference (36 ft.) In most cases the count was direct, in some only the engine revolutions were taken, the car revolutions deduced from the known relation of revolutions.

As will be seen by reference to the plotted observations (Fig. 1), the resistance to the rods was separately determined, and for three cases: Four rods, three rods and two rods. This, because in testing very short bodies it was not possible to attach four rods. Although the formula for long rods, given above as by Theisen, sets forth a law of variation very different from that to be shown in this paper, yet at 100 miles per hour the resistance for four rods, as per experiment, and as per formula of Theisen, are almost identical. Below that Theisen's values are lower than would appear here. The resistance per unit in the case of four rods is considerably less than in the case of two rods, probably owing to the protection, in the former case, of the rear by the front rods.

The rod resistance for each case, when subtracted from the total, gives the lines plotted in Fig. 2.

The general body of air, in such a room as used, is given a rotary movement by the rotation of the rigid system. The true relative velocity of the air and the body can be known only when this general rotary velocity is known. No accurate measurement was made for this purpose, and, indeed, it is almost impossible to make such measurement, as it should be made in the very path of the experimental body. Tell-tales, consisting of vertical sticks carrying light strips of paper, were stuck just within and just without the path of rotation. These strips in all cases showed marked pulsation of the disturbance, and the direction taken by them did not vary more than 15° from the radii drawn through their bases. This almost radial flow is due to the fact that the body is indeed pushing the particles apart, outward and inward, as well as forward, and this lateral flow, by the time the rotating body has traveled a semi-circumference past a tell-tale (or other point), has so disturbed any tangential current as to make the general rotary velocity very small. Light objects, placed near the moving body, were blown outward or inward, almost exactly along a radius. This matter has been quite carefully experimented upon by Robinson and Recknagel, and especially by Dohrandt, who determined, in anemometer experiments, this "mit-wind" velocity as 5 per cent. of the velocity of the whirling machine.

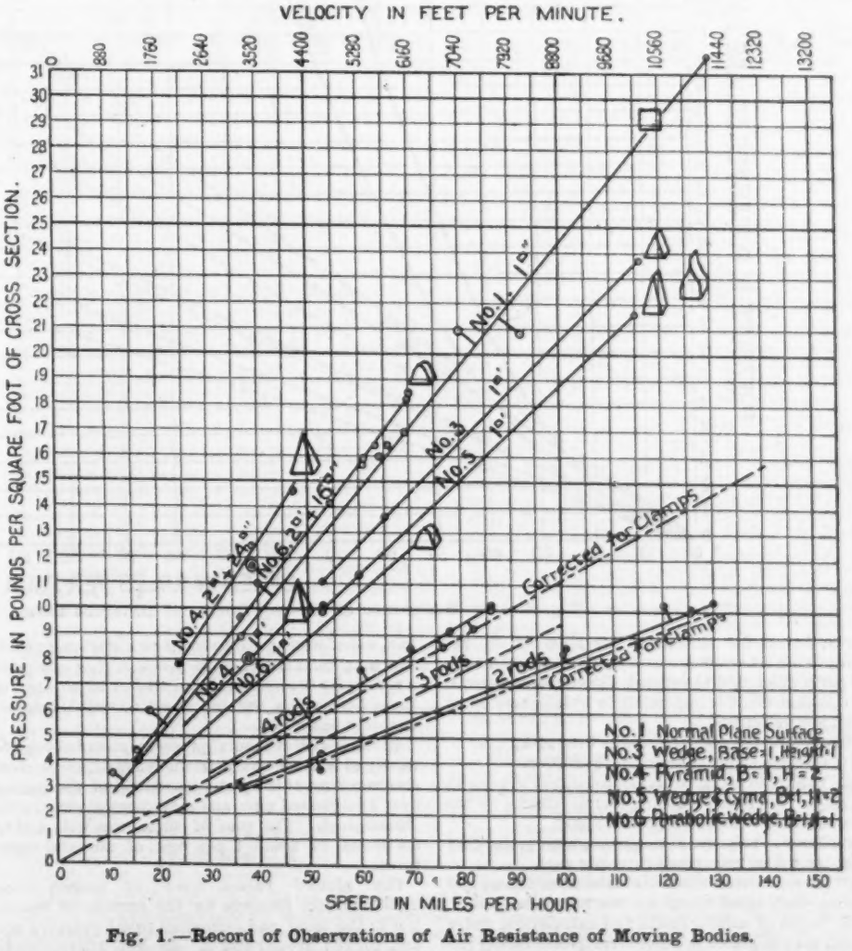


Fig. 1.—Record of Observations of Air Resistance of Moving Bodies.

* A paper read before the West Point branch of the Military Service Institute.

This value was also adopted by Recknagel. Robinson obtained values as high as 10 per cent., but himself considered them as exaggerated by reason of the inertia of his mechanism, which recorded a velocity much higher than that existing at the instant the body passes a given point, which velocity of "mit-wind" is the minimum of a pulsating value whose maximum is always just behind the body, and not in front of it.

I have, however, drawn a curve (Fig. 2), showing 10 per cent. increase of recorded pressures. This increase, I believe, will cover both the corrections (mit-wind and friction); at low velocities, there is no appreciable remaining rotary movement when the body returns to a given point. At extremely low velocities, since the resistance of friction remains constant, this 10 per cent. does not cover all

The result from running a car, having a cross-section of 5.1 sq. ft. at velocities of about 50 miles per hour, and recording atmospheric pressure against this car head. The runs were made on a track about two miles in circumference, hence all question as to mit-wind ceases. The movement was practically rectilinear. The front of the car was made of a wooden plate, mounted on single rollers and free to move against a spring, the spring pressing against a rigid cross-bar in the car. The head-plate carried a pencil pressing against a chronograph placed inside the car. The car was propelled by electric motors, its velocity being obtained from the record of a number of observers stationed at intervals along the circular track. Two runs were made with the chronographic apparatus, and readings for maximum velocity are given on Fig. 2. A third

tions above 30 miles being numerous, thus affording data sufficient to show clearly the velocity relation throughout this latter range from about 30 to 130 miles per hour.

On examining the plotted record of these experiments for information concerning the various branches of the general inquiry, as above divided, we were at once struck by the rectilinear relation between velocity and pressure.

This was altogether surprising to Mr. DASHIEL and myself, and, by reason of its variation from general authority, was in a certain sense unwelcome. The close accord of all the observations leaves, on this point, no room for doubt unless there be found some systematic error varying regularly in such a way as to absorb all the pressure due to V^{a-1}, "a" being the true exponent. No such error has been discovered.

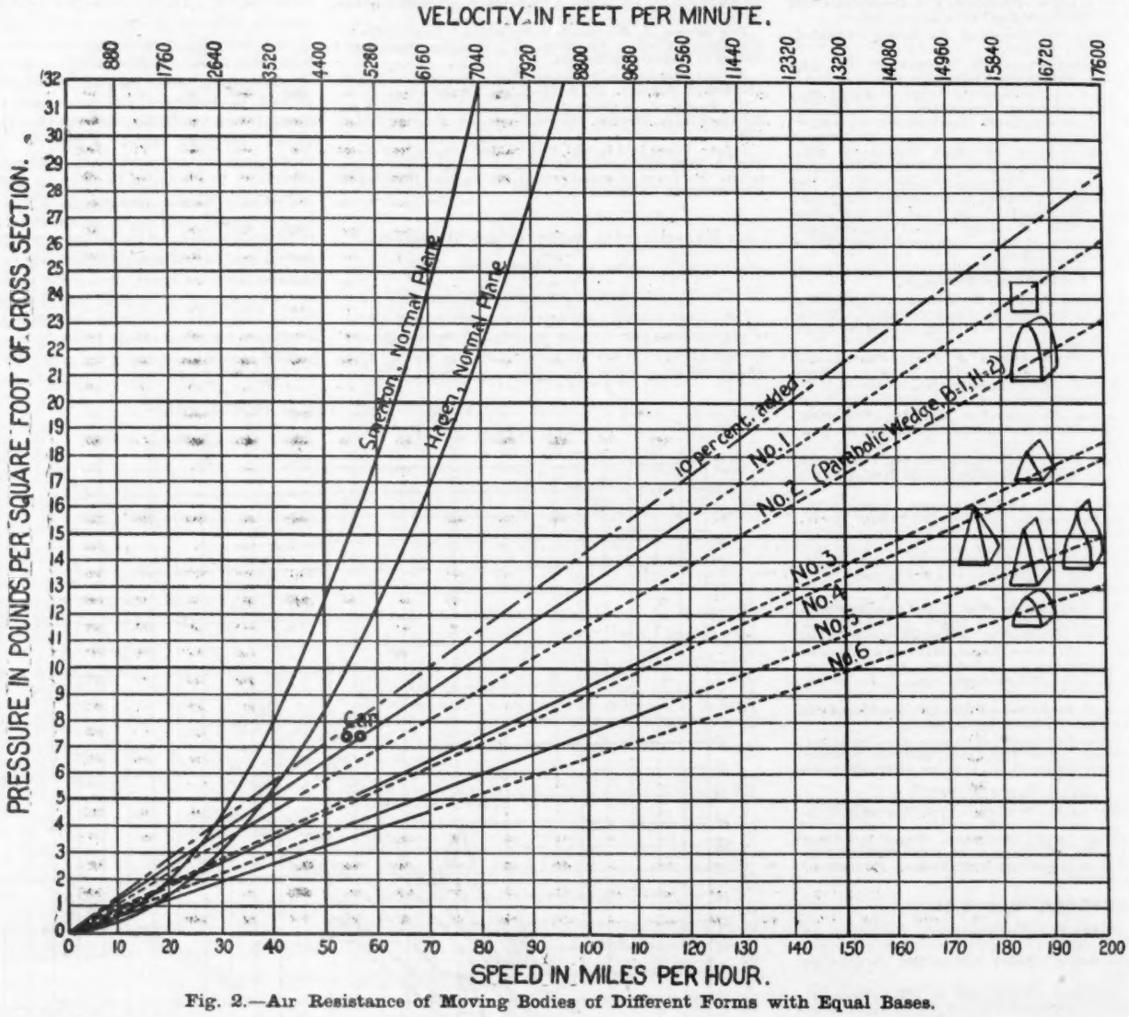


Fig. 2.—Air Resistance of Moving Bodies of Different Forms with Equal Bases.

error, hence for velocities less than 300 ft. per minute no accuracy is claimed. As is usual, inertia of parts was found to present difficulties—indeed it is this that made it impossible to obtain results at very low velocities.

The errors affecting the results here given are:

(1) Possible errors in count of revolution.

(2) Failure to preserve perfect constancy of velocity during a run, thus producing inertia effects in the line assumed to measure pressure only.

(3) Error in measure of mit-wind, with probability that error does not exceed three per cent.

(4) Error in determination of friction of collars and spring—very small except for low velocities.

(5) Errors of measurement and calculation, under which may be placed possible error in calibrating the springs.

Of these (1), (2) and (5) would probably be compensatory in a considerable number of observations. That they are nearly so, and that (3) and (4) are comparatively unimportant appears from the remarkable agreement of the readings between 50 and 60 miles per hour with other readings obtained under different conditions. Two of these are shown on Fig. 2,

run, not plotted, gave a record on a stationary card. The maximum travel of the pencil in that case gave a result, for 50 miles per hour, within 10 per cent. of those here given, but the exact record has unfortunately being lost.

In these cases the total pressure recorded rises to nearly 40 lbs. The only frictional resistances were due to rolling of the plate, movement of the spring over a lubricated pipe, and movement of pencil over chronograph. The sum of these was well within 0.5 pound, or about 1 per cent. of the total registered.

The plotted values result, of course, from dividing total pressure by the number of square feet in the head and assuming equal pressure per unit for the areas 1 and 5. As seen above, this is known to be very nearly true. The determination of velocity is subject to a possible error of 5 per cent, I cannot but consider this close agreement of results from different methods as an indication of great trustworthiness throughout the range of experiment.

It will be noted that the experimental velocities ranged from 10 to 130 miles per hour, the observa-

Departing as this relation does from that usually assumed, I cannot find any series of observations more exact and more extended than these, and in themselves establishing over the range here covered, the relation P varies as V.

While I do not consider it a necessary task to frame a theory explanatory of the rectilinear function disclosed by the records here presented, and while I am not sure that one can now be framed, yet the following consideration seems to be of some value. It was set forth by Dubuat in his great treatise (and perhaps by others before him) that a sort of fluid prow is built up in front of an object having motion relative to the surrounding fluid. This was particularly stated with respect to motion in water, as some sort of visible evidence may be had in that case. Let us suppose, as does Dubuat, that the same thing occurs in the case of motion in air. Indeed, it seems that, by reason of its compressibility, a resisting or resisted gas would more readily form into a head volume of abnormal density, the shape of whose limiting surface (or more accurately, merging boundary) may be the function of the perimeter of the solid and of the velocity of relative movement. This

shape may then become more and more favorable (*i. e.*, the true angle of incidence may become smaller and smaller) with increase of velocity, up to some limiting velocity and shape. Within this range of changes in the fluid prow, the change may be such as to defeat the law of the squares, to which we are, deductively, most readily brought.

Beyond such range the law of the squares may establish itself; still further, this law may again be departed from by reason of rapid increase in the "non-pressure" at the rear (this is Dubuat's term) and the law of the cubes or high powers may appear; and yet further, this "non-pressure" reaching a limiting value, or possibly becoming constant, a return to the square may be found. Thus, possibly, the changes in the exponent of V, insisted upon by the highest authority in ordnance practice, may be explained. That there should be some change in the pressure-velocity relation in case of great change in the velocity, we are led to expect from the latest and best studies of the dynamics of gases (see Art. "Atom" in Enc. Brit.). There is beyond question local change in density of gases due to change of relative velocity of gas and solid; how far this may go we do not know.

But with change of density there is change in the relative value of pressure due to kinetic energy of individual particles, and that due to interaction of component particles each upon the other. Owing to this change, those laws supposed to be most general—such as Boyle's law—are found to apply with varying accuracy under wide ranges of density.

Recognizing the great difficulty of the problem from a theoretical standpoint, and having become acquainted with the conflict of previous experiments, I feel it not unreasonable to accept the rectilinear relation over the given range, until other experiments may conclusively show the error of those now presented.

We should then write, for velocities from 30 to 130 miles per hour and for 1 sq. ft. cross-section, with prolongation of body to the rear (see Fig. 1),

$$P = 0.131\ V \qquad \text{or,}$$

if the 10 per cent. increase for "mit-wind" effect be added,

$$P = 0.1441\ V,$$

P being in pounds per square foot, V in miles per hour.

In applying this to larger surfaces than 5 sq. ft (the area of the car run at 50 miles per hour), it may be necessary to apply some correction. No value for this correction can now be given, as the whirling experiments, with 1 and 2 sq. ft., and the car experiment, with 5 sq. ft., disclose no clear difference in pressure per unit of surface.

To show that the formulæ hitherto accepted are much at fault, either in the determination of constants, or in the form of the function, let us apply various values of atmospheric resistance to some practical cases.

From dynamometer records taken on a N. Y. Central passenger train, Mr. P. H. DUDLEY found 766 H. P. developed at 51.4 miles per hour. The train consisted of engine, tender, three day and six sleeping coaches.

Surface exposed (reduced in the matter of shape):

Engine.	Sq. ft.
Boilers	16
Cylinders	8
Cow-catcher	12
Cab	20
Fire-box	10
Head-light and smoke-stack	6
Driver	8
Swiveling truck and wheels	8
Sand box, dome, whistle, bell, pipes, rods	10
	98
Or very nearly	100
Tender	30
First car front	50
Eight additional car bodies (separated by about 6 ft.) and covering window irregularities, etc	120
80 wheels, 40 axles	40
Trucks, brakes, steps, etc	50
Total for train	390

Atmospheric resistance:	Pounds.
(a) Following Smeaton's rule	5,304
(b) " Hutton's "	5,538
(c) " Hagen's "	4,290
Total recorded pressure	5,585
Leaving for all other resistance:	
(a) Smeaton	281
(b) Hutton	47
(c) Hagen	1,295

From a careful test by indicator cards, made on the same railway, October, 1889, Mr. SINCLAIR obtained for a velocity of 52 miles per hour, and for a train of seven vestibuled cars, total horse power developed (mean of several results) 664, or, in pounds, 4,788.

In this case we have a reduction in surface exposed:

For vestibule—say ft. on 7 cars	50
Two car-bodies, 16 wheels, etc	45
	95
Leaving nearly	300
Then, again, for this surface:	
(a) Smeaton	4,080
(b) Hutton	4,260
(c) Hagen	3,240
Subtracting from 4,788, we have:	
(a)	708
(b)	528
(c)	1,548

When it is remembered that about 6% of the total horse power developed, as from indicator cards, should be taken to cover friction of machinery in the engine, it is evident from the very small remainders given above, that atmospheric resistance by any of the above formulæ is much overestimated, as in some cases practically nothing is left for the work of friction and oscillation, the maximum (Hagen) being about 4 lbs. per ton. The application of Hagen's formula is rendered slightly uncertain by reason of many variations in the magnitude of the perimeter. It has been assumed that the average perimeter could be taken as 8 lin. ft.

The remainders in the two cases given become, according to the determinations here presented, about 2,000 and 2,500 lbs. respectively, values which are at least reasonable. They show about 8 lbs. per ton frictional and oscillatory resistances; it will be agreed by those familiar with the subject that this figure is certainly low enough, hence the value for atmospheric resistance high enough.

As to branch C, the average of results from Theissen, Wenham & Browning, Hutton, and those now recorded, if not inaccurately expressed by the simple formula:

$$\frac{\cos.\ \varphi + \cos.^2\ \varphi}{2}$$

It is presented with the belief that, while not proven to be absolutely accurate, it seems to be an excellent and simple guide.

A practical application of some interest, and which I have not elsewhere seen, arises in determining the total pressure in direction of motion in case a certain base area is to remain constant, the angle of the head being changed. In this case the area exposed increases with sec. $\varphi = \frac{1}{\cos.\ \varphi}$. Multiplying the above expression for pressure per unit area by this expression for increase of area, we have:

$$P = \frac{1 + \cos.\ \varphi}{2}.$$

It will be noted that the pyramid, of equal obliquity with the longer wedge, gave resistances considerably higher. This is probably to be explained by the fact that the four masses of air thrown outward by the four faces interfere along their boundaries, resulting in greater lateral density than in the case of the dihedral angle. Moreover, the lower face, having its lower edge only three inches from the floor, doubtless met a somewhat greater resistance, due to the crowding of the air under the car.

The beneficial effect of curved surfaces is shown in the low value of P given by the parabolic wedge. It reduces the pressure as compared with normal pressure on its base by one-half.

Changes in the length of the body and also in shape at rear were tried, but no appreciable differences established.

Concluding, I should say that, although the experimental results here recorded seem trustworthy, and cannot now be distinctly overthrown or set aside, yet, by reason of the great conflict of evidence, this important matter of atmospheric pressure calls for a very extended and careful series of tests. The cost of determining formulæ true beyond any question would be repaid many times every year in applying them to the true economy of engineering structures.

PERSONALS.

Mr. J. F. LE BARON, late in charge of engineering work on the Nicaragua canal for about two years, has opened an office at 61 Broadway, New York, Room 28, as civil and consulting engineer. Mr. LE BARON has had extensive experience in railway and canal work, general municipal work, sewerage and water-works.

PROF. JAMES CLEMENT MOFFAT, D. D., died recently at his residence on Mercer St., Princeton, N. J. Dr. MOFFAT was born in Scotland in 1811. In 1831 he came to the United States and graduated from Princeton in 1835, and, after a two years' post-graduate course at Yale, was elected Professor of Greek and Latin in Lafayette College.

From 1839 to 1841 Mr. MOFFAT was connected with Miami University, Ohio, and in 1851 was licensed to preach, and, after spending two years as instructor of Greek and Hebrew in the Cincinnati Theological Seminary, he became Professor of Latin and History in Princeton College, and later in Greek. In 1861 he was elected to the Chair of Church History in the Theological Seminary, which he held until two years ago, when he was made Professor Emeritus. He was the author of several books on theological subjects and a large contributor to the magazines.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The following additional papers are announced for presentation at the convention:

"The Three River Spans of the Bridge Recently Completed Across the Ohio River at Cincinnati," William H. Burr; "The Beginnings of Engineering with Special Reference to Early Engineering Science in America," J. Elfreth Watkins; "On Truss Bridges," Onward Bates; "One Way of Obtaining Brine," Charles B. Brush; "The Self-Registry of Effects of Strain in Metals," Robert H. Thurston; "Comparison of Water Supply Systems from a Financial Point of View," J. Leland FitzGerald.

Arrangements are being made both for local accommodation at Cresson and for visits by the courtesy of the Pennsylvania R. R. to a number of points of great interest, including Altoona, Johnstown and other places.

Robert E. Petitt, Theo. N. Ely, F. L. Sheppard, Robert Pitcairn, A. C. Hippey, O. E. McClellan, M. Trump, John Bogart, Committee.

Engineers' Club of St. Louis.—Meeting, May 21, 1890, Prof. Nipher presiding, 19 members and 3 visitors present. The paper of the evening, by George A. Brown, entitled "The Function of the Government in a Plan for General Irrigation," was then read by Prof. Johnson. The paper discussed at some length the necessity of providing some more complete and systematic method of dealing with the problem of the artificial distribution of water for purposes of irrigation. The author claimed that the arid region was nearly as great in extent as the remaining portion of the country, and the land was of but little value without water rights. The government is now asked to determine the amount of water available for the purpose, and to provide laws regarding its distribution and apportionment. He thought the government should give a title to certain water privileges, the same as it gives to land. In the discussion, Professor Nipher said that experiments extending over a long period of years had demonstrated that the apparent increase in rainfall in forests was due to the fact that the rain caught in the gauges was not affected by wind currents. Improved forms of rain gauges had shown that there was no actual difference between the amount of rain falling in forests and in open places. Mr. Robert Moore stated that such investigations as he had been able to make had satisfied him that the popular opinion that forests increased the amount of rainfall was a fallacy, and he was glad to see the matter set at rest authoritatively. Messrs. Johnson, Blaisdell and Curtis also took part in the discussion.

WM. H. BRYAN, Secretary.

Engineers' Club of St. Louis.—Meeting June 4, 1890, President Nipher in the chair; 30 members and 3 visitors present. Col. Meier, president of the committee on Eads' monument, announced the formation of the Eads Monument Association, and suggested the advisability of members of the club joining the association. On motion of Prof. Potter it was ordered that the committee on local data be continued, with authority to employ expert assistance, if necessary, to edit the report, and to secure for the club estimates on the cost of publication, the treasurer to be made a member of this committee when matters of expense were under consideration. Prof. Nipher called attention to the fact that rainfall in the State of Missouri was almost exactly equivalent to the river discharge at St. Louis. It was on motion ordered that an extra meeting be held on June 18.

WM. H. BRYAN, Secretary.

Western Society Civil Engineers.—At a meeting of the society on March 5, Messrs. O. Chanute, F. C. Carter, J. F. Wallace, M. Seifert and W. E. Williams were appointed a committee to make a report in regard to the regulation of the construction and maintenance of highway and railway bridges in the interest of public safety by legislation. The Committee wish to secure information and data upon the following points: 1. Foreign custom and laws in regard to the construction and inspection of railway and highway bridges. 2. The manner in which this question has been treated and any legislation had thereon in the United States. 3. The points in bridge designing and construction which need special attention. 4. Former bridge accidents and their causes. 5. Standard plans and designs of railway bridge floor systems. Any information or suggestions will be appreciated by the committee. Address, "Committee on Bridge Legislation," Western Society Civil Engineers, 78 La Salle Street, Chicago.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

Vol. XXIII. Saturday, June 14, 1890.

D. McN. STAUFFER A. M. WELLINGTON
EDITORS.
CHAS. W. BAKER E. E. R. TRATMAN M. N. BAKER
ASSOCIATE EDITORS.
GEO. H. FROST.....BUSINESS MANAGER

SUBSCRIPTIONS.

To United States, Canada, and Mexico.

One Year, **$5.00;** *6 months,* **$2.50;** *3 months,* **$1.50;** *Single Copies, 12 cents. To all* **Foreign Countries** *in the Postal Union, add $2.08 to above prices for postage.*

CLUB RATES.

Two new subscriptions	$9.00
One renewal and one new subscription	9.00
Five new subscriptions	20.00
One renewal and four new subscriptions	20.00

Subscribers *can have the mailing address of their paper changed as often as they desire. Send both the old and the new addresses.*

The date *when the subscription expires is on the address label on each paper, the change of which to a subsequent date becomes a receipt for remittance.* **No other receipt** *is sent unless requested.*

Advertising rates. 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon;* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if those who fail to receive their papers promptly will notify us without delay.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Engineers' Club of Philadelphia, Pa.—Next meeting, Secy., Howard Murphy, 1122 Girard St.

Engineers' Club of Kansas City, Mo.—Secy., Kenneth Allen, 900 Baird Building.

Master Car-Builders' Association.—Secy., J. W. Cloud, Buffalo, N. Y.

Civil Engineers' Club, Cleveland, O.—Next meeting, July 8. Secy., C. O. Palmer, 22 Cedar Ave.

New England Railway Club, Boston Mass.—Sec., F. M. Curtis, Old Colony R. R. Rooms in the United States Hotel.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting, July 9. Secy., J. C. Herring, Wichita.

New England Water-Works Association.—Secy., E. C. P. Coggeshall, New Bedford, Mass.

Civil Engineering Society (Mass. Inst. of Technology), Boston, Mass.—Secy., Clement March.

New York Railway Club.—Rooms, at 113 Liberty St.

Engineering Association of the Southwest, Nashville, Tenn.—Next meeting, July 10. Secy., Olin H. Lardreth, Vanderbilt University.

American Railway Master Mechanics' Association.—Annual convention at the Hygeia Hotel, Fortress Monroe, Va., June 17. Secy., Angus Sinclair, 140 Nassau St., New York.

Western Railway Club, Chicago, Ill.—Next meeting, June 17. Rooms in the Phœnix Building. Secy., W. D. Crosman.

Engineers' Society of Western Pennsylvania.—Next meeting, June 17. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, June 18. Secy., S. E. Tinkham, City Hall.

American Society of Civil Engineers, New York.—Next meeting, June 26, Annual convention, at Cresson, Pa. Secy., John Bogart, 127 E. 23d St.

Western Society of Engineers, Chicago, Ill.—Next meeting, July 2. Secy., J. W. Weston, 230 La Salle St.

Association of Civil Engineers, Dallas, Tex.—Next meeting, July 4. Secy., E. K. Smoot, Elm and Austin Sts.

Civil Engineers' Society, St. Paul, Minn.—Next meeting, July 7. Secy., Geo. L. Wilson, City Hall.

Engineers' Club of St. Louis, Mo.—Next meeting, Sept. 17. "The Telescope," by O. L. Pelitdidier. Secy., W. H. Bryan, 309 So. 7th St.

American Society of Railway Superintendents.—Annual meetings in New York, in the Fall. Sec., C. A. Hammond, 350 Atlantic Avenue Boston, Mass.

THE list of technical papers to be read at the coming Cresson Convention of the American Society of Civil Engineers now numbers fifteen, a more liberal allowance than usual, and as far as can be learned from their titles they are excellent papers. This list is especially gratifying as showing that this Society is, after all, not so poverty-stricken in the line of papers as the baldness of the notices of meetings for some time past would quite naturally lead an observer to suppose. The probable explanation is that there has been some accumulating of papers for the convention, starting cautiously with the few in hand to make sure of some acceptable material on that occasion, and at the last moment finding that members contributed more generously of their experience than was expected. This caution is commendable, in the sense that a convention without papers would be a sorry affair; but any meeting without a regularly set topic for discussion is also more or less unattractive, and quite as much effort should be made to avoid a famine in that direction as in the other. The average number of technical papers read before the society, for some years past, seems to range between 25 and 30 per annum, including important discussions; and out of a list of 1,000 active members this is only one paper per year to every 33 members of the society, taking the larger number as a basis. This is certainly not too much to expect, even of the most actively employed engineers, and any falling off in the proportion was to be deplored. Up to May 1, 1890, the transactions of the society contained only six published papers, and as no more were announced for some time after that it was only natural that there should have been some anxiety as to the general average for the year.

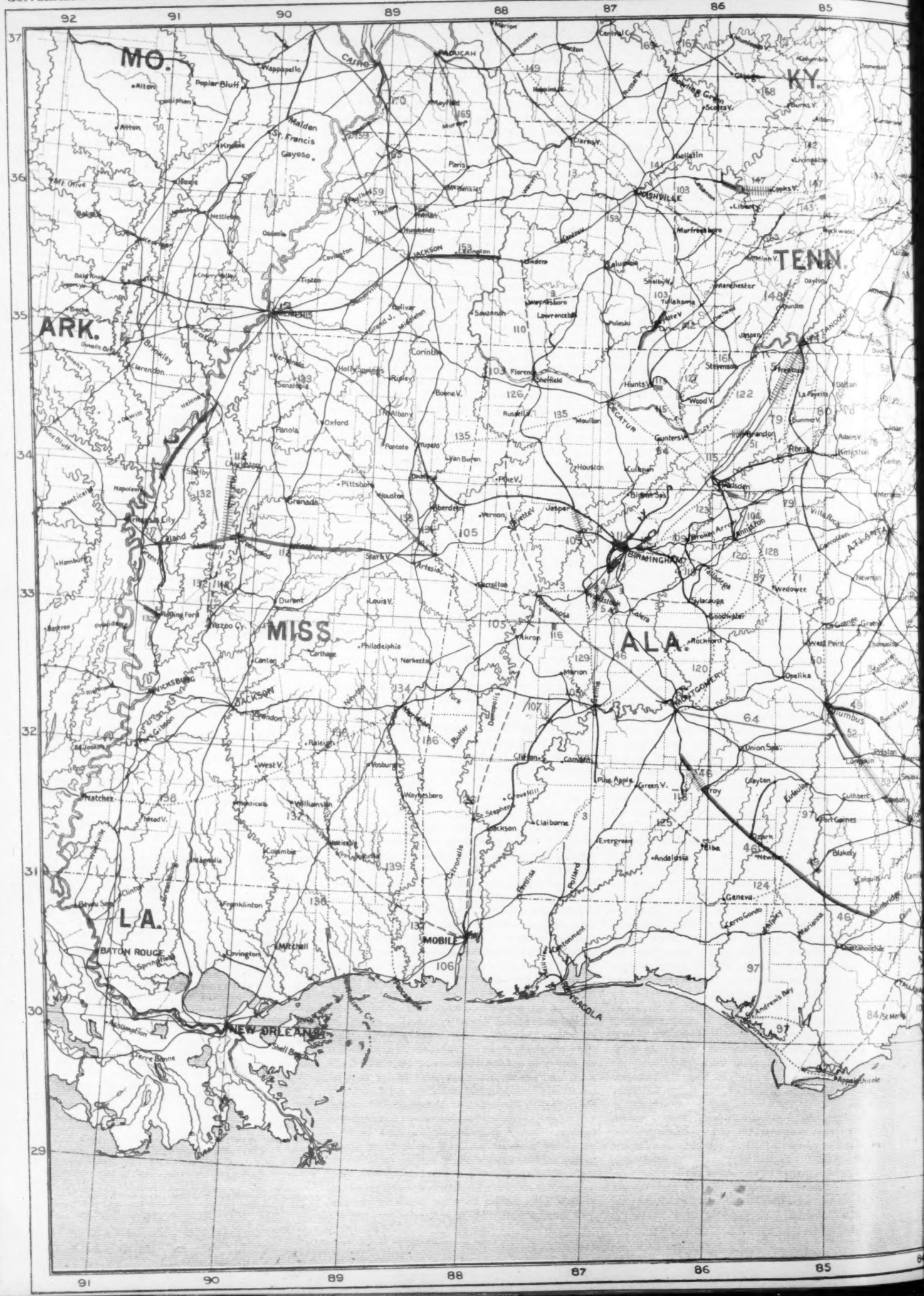
The Convention list restores the balance bravely, and every well-wisher of the society must rejoice thereat and hope that the good work will continue through the Fall of 1890. As an engineering journal we have had our "little growl" and sounded our note of warning, and may or may not have had some small share in swelling the convention list. But just at this moment the oldest, strongest, and most honored of all the American engineering societies can not afford to show any sign that might be mistaken for failing strength or waning interest, however false that sign might be; and good papers, and plenty of them, are the surest index of the earnest effort and active interest of its membership.

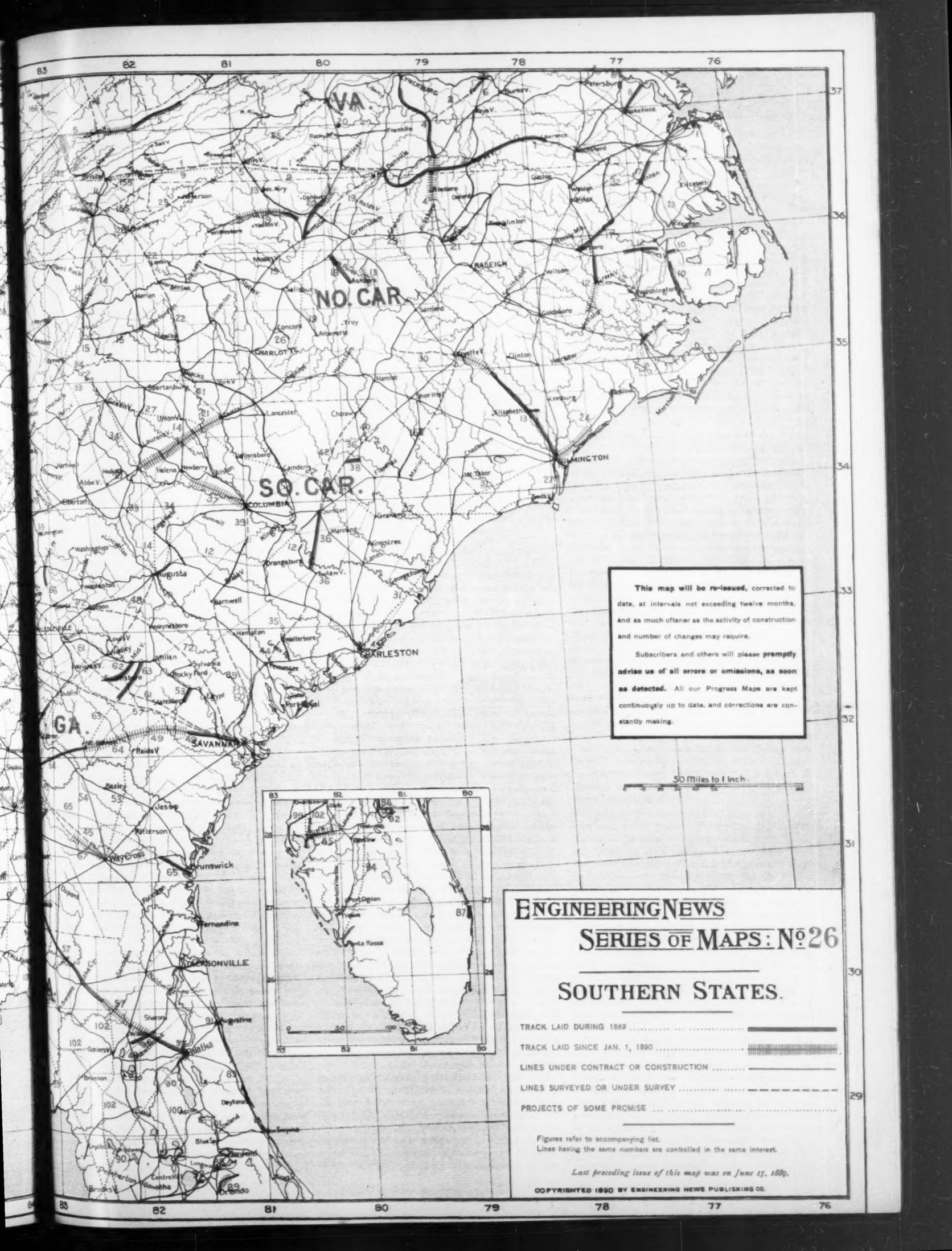
A CORRESPONDENT who evidently feels a deep interest in the rapid transit question, writes us protesting against the method in which it is now being handled by wise experts, and urging that an earnest effort should be made to have the whole question placed in the hands of a board of engineers and transportation experts. Abstractly he may be right, but practically, there is little chance that under present conditions any such action will be had, nor are we clear that it ought to be had. What is the best system for New York, an underground, or sunken, or moderately elevated or very much elevated system? We do not hesitate to say that either is the best which capitalists will undertake to build under conditions favorable to the public. Engineers cannot ensure such conditions or give a better opinion on what capitalists will do than anyone else. What is the best route? That which will accommodate the most people, or in other words, bring in the largest eventual gross receipts, other conditions being equal. We do not know that engineers' opinions upon this point either would be particularly valuable.

Those who are proposing to themselves build rapid transit lines, it is true, whether public authorities or private companies, would be acting very foolishly did they not seek the advice of engineers before deciding definitely on their plans, but that is a very different matter from putting the problem in its present inchoate condition into the hands of engineers for a "first approximation." We don't think there is any chance of this being done, in the first place, and we should not expect any particularly happy result from so doing in the second place. One thing only can be counted on with certainty. New York must and will have true rapid transit to the Harlem River and beyond, and that before long. Probably it will be done under the auspices of the present elevated railway company if it chooses to furnish the real article; but if it does not others can and will. The particular plan and the particular route are minor questions.

IN the line of our late editorial concerning the practical benefits to be derived by corporations and water companies from official representation at the meetings of the Water-Works Association, we notice a full and useful report on the Chicago Convention, made to the Executive Board, of Rochester, N. Y., by their Chief Engineer, Mr. J. NELSON TUBBS. From the context we infer that the Board was officially represented by Mr. TUBBS, at Chicago, but whether this gentleman was there at his own expense or not, his visit was evidently a profitable one to Rochester in the information gleaned and adapted to present or future use. If official representation at water-works conventions were made the rule, rather than the exception, by all controlling water-works, the usefulness of such meetings would be vastly extended by reason of the increased volume of available experience. We can suggest no better method of educating water-works superintendents and keeping them posted in a rapidly advancing practice; and, as we said before, the real profit, in the application of the knowledge gained, belongs to the taxpayer and to the owner, rather than to the superintendent personally.

THAT the alleged phenomenon called "imperceptible slip" of locomotive driving wheels is a non-existent one under any working conditions has been again shown experimentally in the tests which we record elsewhere, covering speeds from 61 miles per hour down. It is still not at all uncommon to see this alleged phenomenon referred to as an undoubted fact in foreign technical literature, but that it is impossible when an engine is doing anything like full work should be evident from the fact that the coefficient of friction falls enormously when the drivers begin to slip, and that this occurs when slipping *begins*, so that it matters not whether the slipping be great or little, three-fourths at least of the power of the engine disappears when slipping begins. There is therefore, but one condition under which this phenomenon can actually occur, viz., when a quarter or less of the usual power will suffice to give a high velocity. These conditions can only exist on a pretty sharp down grade with little or no train behind the engine. Under these conditions it may occur as follows: Any engine can slip its drivers; usually when it does so steam is shut off at once, but if this be not done, and there happens to be a down grade as well as steam to help the engine along, and it has little or no train to hold it back, it may continue to acquire a high speed nevertheless, the wheels still slipping; possibly as much as 60 or 70 miles per hour. There is nothing mysterious nor "imperceptible" about such slip; it is merely plain, ordinary slip; and any man with ordinarily quick sense can detect the instant it begins if on the watch for it. It can never occur on an up grade or on a level; or with any but a light engine: or without consciously or unconsciously abusing the machinery, precisely as ill-tempered runners will sometimes do when they simply "let her spin" after more or less unsuccessful attempts to start a heavy train without slipping. Therefore while not wholly without some foundation in fact, it is not worth serious attention as a phenomenon con-


MO.
KY.
TENN.
ARK.
MISS.
ALA.
L.A.
L.A.
CAIRO
PADUCAH
MEMPHIS
NASHVILLE
JACKSON
VICKSBURG
MONTGOMERY
BIRMINGHAM
MOBILE
NEW ORLEANS
BATON ROUGE
PENSACOLA
Poplar Bluff
Wappapello
Malden
St. Francis
Cayoso
Mt. Olive
Osceola
Tiptonville
Brownsville
Bolivar
Grand J.
Middleton
Corinth
Holly Springs
Senatobia
Oxford
Panola
Pontotoc
Tupelo
Houston
Pittsboro
Grenada
Aberdeen
Vernon
Jasper
Pikeville
Blount Spg.
Cullman
Decatur
Huntsville
Florence
Sheffield
Russellville
Moulton
Guntersville
Gadsden
Attalla
Anniston
Talladega
Sylacauga
Wedowee
Rockford
West Point
Opelika
Columbus
Union Springs
Troy
Dayton
Eufaula
Clayton
Cuthbert
Fort Gaines
Blakely
Tolquitt
Geneva
Andalusia
Evergreen
Claiborne
Jackson
St. Stephens
Grove Hill
Camden
Pine Apple
Greenville
Selma
Marion
Akron
Carrollton
Durant
Louisville
Starkville
Artesia
Columbus
Aberdeen
Okolona
Pontotoc
Ripley
Corinth
Iuka
Florence
Sheffield
Tuscumbia
Decatur
Athens
Pulaski
Lawrenceburg
Waynesboro
Savannah
Shelbyville
Manchester
Tullahoma
Murfreesboro
Lebanon
Gallatin
Hartsville
Cookeville
Livingston
Jamestown
Albany
Somerset
Columbia
Lebanon
Springfield
Clarksville
Hopkinsville
Princeton
Madisonville
Henderson
Owensboro
Bowling Green
Scottsville
Glasgow
Tompkinsville
Burkesville
Liberty
Harrodsburg
Lancaster
Danville
Stanford
Somerset
Monticello
Whitley
Williamsburg
London
Corbin
Barbourville
Pineville
Middlesboro
Cumberland Gap
Jonesboro
Johnson City
Bristol
Kingsport
Rogersville
Morristown
Greeneville
Newport
Sevierville
Maryville
Knoxville
Harriman
Kingston
Rockwood
Athens
Cleveland
Chattanooga
Dalton
Rome
Summerville
Lafayette
Trenton
Stevenson
Scottsboro
Guntersville
Albertville
Boaz
Gadsden
Attalla
Rainsville
Fort Payne
Valley Head
Collinsville
Centre
Piedmont
Jacksonville
Anniston
Talladega
Sylacauga
Childersburg
Talladega
Alexander City
Wetumpka
Montgomery
Prattville
Autauga
Selma
Marion
Uniontown
Demopolis
Livingston
Eutaw
Greensboro
Tuscaloosa
Northport
Carrollton
Pickens
Aliceville
Columbus
Starkville
Macon
Meridian
Quitman
Enterprise
Laurel
Hattiesburg
Wiggins
Gulfport
Biloxi
Pascagoula
Ocean Springs
Pass Christian
Bay St. Louis
Waveland



This map will be re-issued, corrected to date, at intervals not exceeding twelve months, and as much oftener as the activity of construction and number of changes may require.

Subscribers and others will please **promptly advise us of all errors or omissions, as soon as detected.** All our Progress Maps are kept continuously up to date, and corrections are constantly making.

50 Miles to 1 Inch.

ENGINEERING NEWS SERIES OF MAPS: No. 26

SOUTHERN STATES.

TRACK LAID DURING 1889 .....

TRACK LAID SINCE JAN. 1, 1890 .....

LINES UNDER CONTRACT OR CONSTRUCTION .....

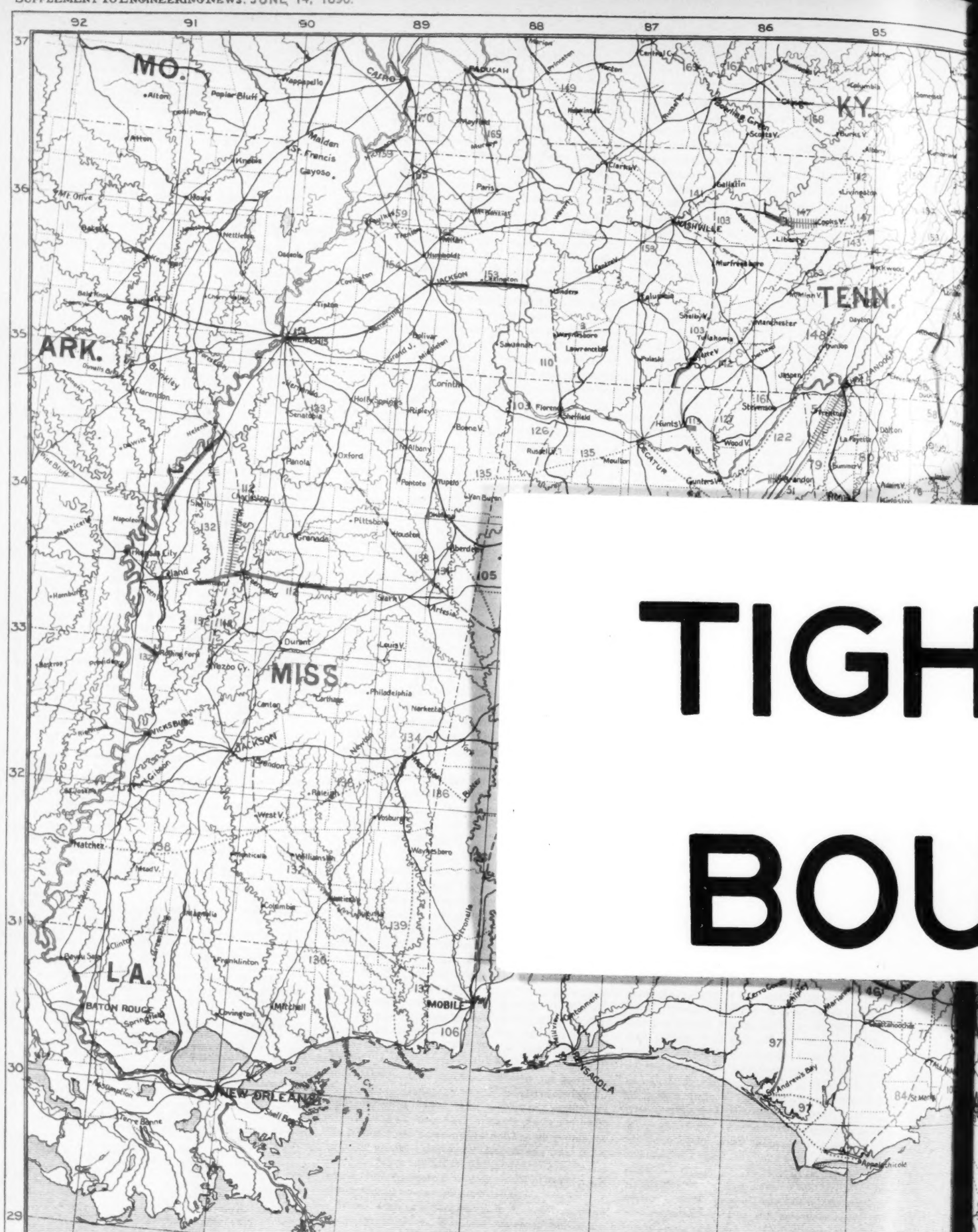
LINES SURVEYED OR UNDER SURVEY .....

PROJECTS OF SOME PROMISE .....

Figures refer to accompanying list.
Lines having the same numbers are controlled in the same interest.

Last preceding issue of this map was on June 15, 1889.

COPYRIGHTED 1890 BY ENGINEERING NEWS PUBLISHING CO.


MO.
KY.
TENN.
ARK.
MISS.
L A.
CAIRO
PADUCAH
MEMPHIS
NASHVILLE
JACKSON
VICKSBURG
BATON ROUGE
NEW ORLEANS
MOBILE
PENSACOLA
TIGH
BOU

This map will be re-issued, corrected to date, at intervals not exceeding twelve months, and as much oftener as the activity of construction and number of changes may require.

Subscribers and others will please **promptly advise us of all errors or omissions, as soon as detected.** All our Progress Maps are kept continuously up to date, and corrections are constantly making.

50 Miles to 1 Inch.

ENGINEERING NEWS SERIES OF MAPS: No. 26

SOUTHERN STATES.

TRACK LAID DURING 1889 .....

TRACK LAID SINCE JAN. 1, 1890 .....

LINES UNDER CONTRACT OR CONSTRUCTION .....

LINES SURVEYED OR UNDER SURVEY .....

PROJECTS OF SOME PROMISE .....

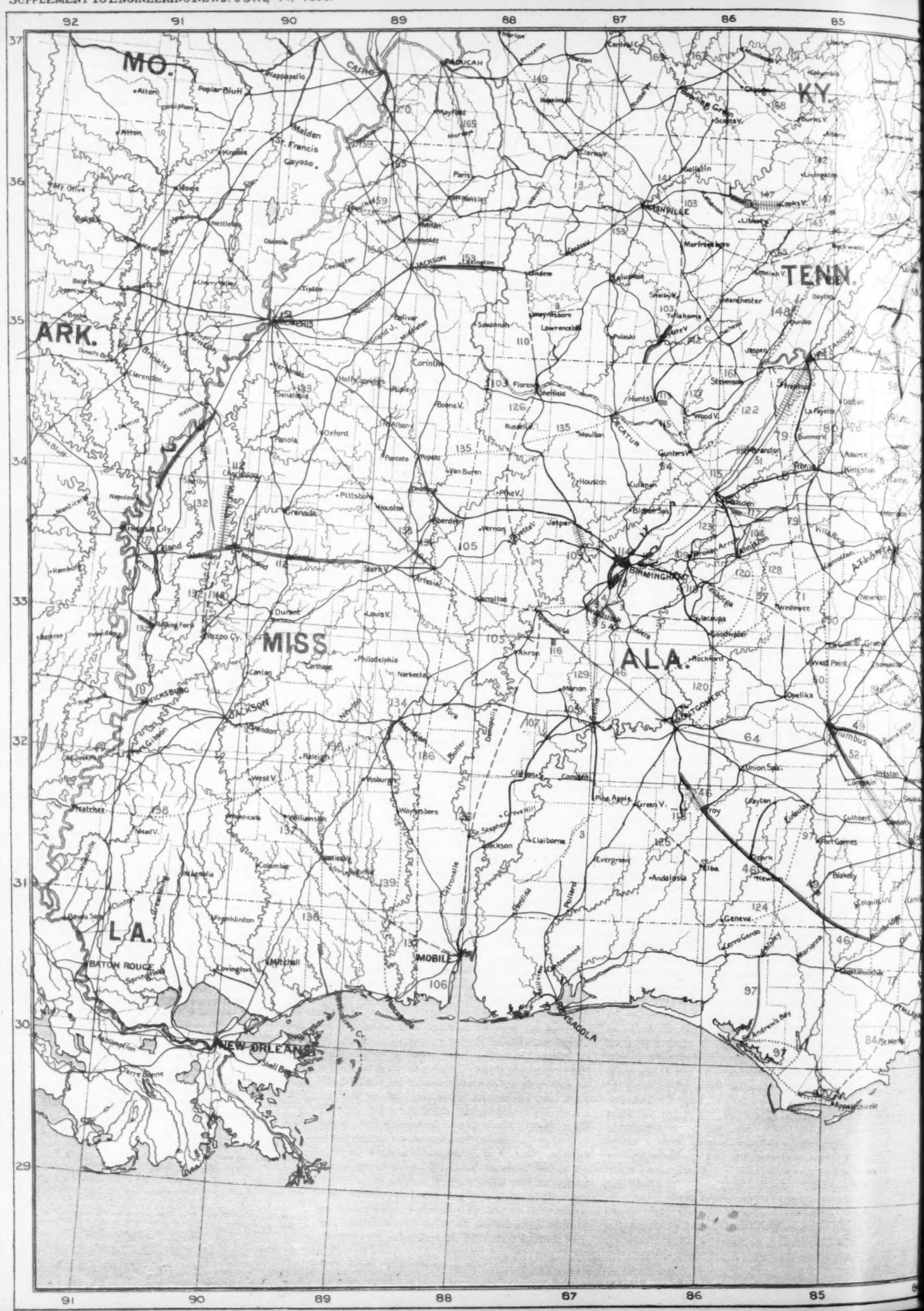
Figures refer to accompanying list.
Lines having the same numbers are controlled in the same interest.

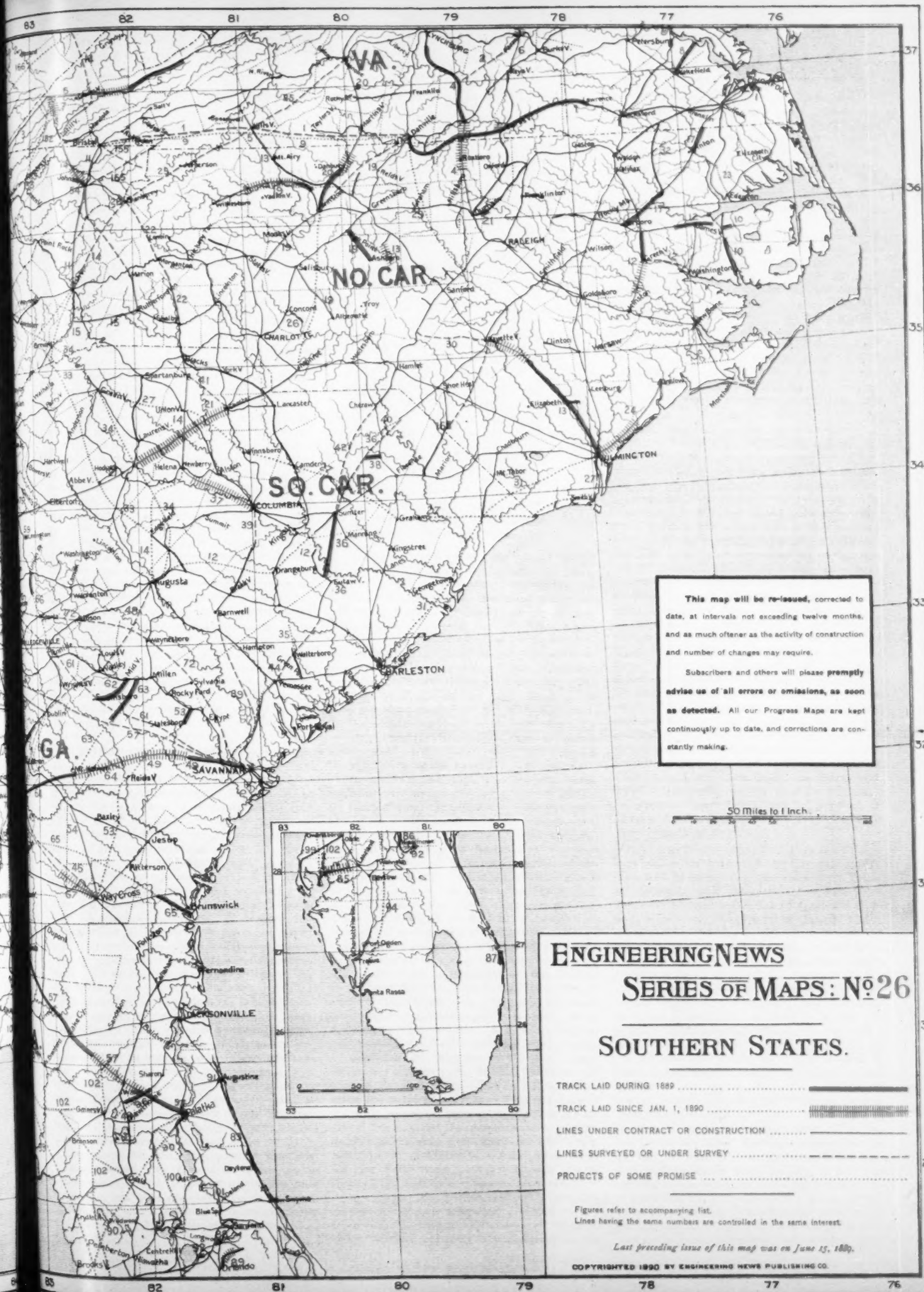
Last preceding issue of this map was on June 15, 1889.

COPYRIGHTED 1890 BY ENGINEERING NEWS PUBLISHING CO.

HTLY

UND


MO.
KY.
TENN.
ARK.
MISS.
ALA.
LA.
CAIRO
PADUCAH
NASHVILLE
MEMPHIS
VICKSBURG
JACKSON
BATON ROUGE
NEW ORLEANS
MOBILE
PENSACOLA
BIRMINGHAM
MONTGOMERY
CHATTANOOGA
92
91
90
89
88
87
86
85
37
36
35
34
33
32
31
30
29



This map will be re-issued, corrected to date, at intervals not exceeding twelve months, and as much oftener as the activity of construction and number of changes may require.

Subscribers and others will please **promptly advise us of all errors or omissions, as soon as detected.** All our Progress Maps are kept continuously up to date, and corrections are constantly making.

ENGINEERING NEWS
SERIES OF MAPS: No. 26

SOUTHERN STATES.

TRACK LAID DURING 1889 .....

TRACK LAID SINCE JAN. 1, 1890 .....

LINES UNDER CONTRACT OR CONSTRUCTION .....

LINES SURVEYED OR UNDER SURVEY .....

PROJECTS OF SOME PROMISE .....

Figures refer to accompanying list.
Lines having the same numbers are controlled in the same interest.

Last preceding issue of this map was on June 15, 1889.

COPYRIGHTED 1890 BY ENGINEERING NEWS PUBLISHING CO.

nected with ordinary, business-like handling of locomotives in any service.

It is not particularly gratifying to our national pride, or to our common sense as a nation, to find the boards of visitors to West Point and to the Naval Academy complaining of the antiquity of the tools with which we teach our future army and navy officers their respective trades. Smooth-bore cannon and sailing ships are very much out of fashion, and while our text-books are doubtless good, object lessons are of much greater service, and without them the education afforded in these institutions is very incomplete.

It is absurd economy of the very worst type for our Congress to grant appropriations to these national schools sufficient for the immediate necessities of the course and yet stubbornly to refuse to add to these appropriations the sums asked for and absolutely necessary to provide high-power modern artillery and examples of the various other new warlike appliances which the officer is supposed to handle immediately upon going into active service. The art of war is advancing with a rapidity that is the characteristic mark of the wonderful age we live in; and just as a technical school would be now practically useless for proper educational purposes without its elaborate physical apparatus of the latest type, and without constant additions to this plant to keep pace with the times, so will our military schools utterly fail in the higher education of its graduates without the means of making them thoroughly familiar with the more advanced practice of their profession. It is too late to wait until they enter upon their active life; they should be at least well informed on the advances made before they leave their schools, and then they may be expected to keep pace with their brother officers of other nations. Our young officers are an unusually bright set of young men, and it is unwise, in a national sense, and unjust to them, to handicap them with poor tools and incompleted training, simply to save a few dollars in the cost of an appropriate plant.

Within little more than sixty days the ocean-traveling public has been called upon to face danger with the breaking up of the engines of the *City of Paris*, and the attempt to run down an iceberg by the *Normannia;* now the Anchor steamer *City of Rome* bumps a hole in her bottom on Fastnet Rock, while striving to make Queenstown in "an impenetrable fog." This is not encouraging to ocean travelers, though we must admit that each one of these three widely different accidents demonstrated the superiority of modern ship-construction, and the great advance made within a few years in quickly handled machinery. The *Normannia* owed its escape solely to twin-screws and the quick wit of its commander; and the passengers of the *Paris* and *Rome* can thank bulk-headed and double-hulled ships for their lives.

But, as we said in a late issue, back of these accidents, and in a great measure, if not solely responsible for them, was the ambition of their commanders to "get there" as quickly as possible, regardless of fogs, icebergs or over-taxed machinery. To save a few hours in an ocean passage of 3,000 miles is deemed worthy of any risk; and the increasing fondness for this "record-breaking" is quite as alarming as the advance in safe construction is, in one sense, gratifying. A little wisely-devised and stringently enforced law is evidently in order in this direction, and, judging from this summer's record, the enactment cannot come much too soon. Time is money in this day and generation; but when some ocean greyhound goes to the bottom with a thousand or more souls, we shall realize that even time may be saved at too great a cost.

Railway Construction in the South.

We present with this issue of Engineering News a map and statistics showing the progress and prospects of railway construction south of the Ohio and east of the Mississippi Rivers. The statistics are made up from official returns for nearly two-thirds of the companies now carrying on construction, and in all other cases are compiled from the best obtainable data, and give, we believe, a fair and correct summary of the progress and status of railway construction in this rapidly developing section of the country. According to the summaries the mileage of railway in the various stages of construction in the several states is as follows:

States.	Track laid.		Under contract or construction.	Located and under survey.	Projects of some promise.
	1889.	1890.			
W. Virginia	53.5	.....	296.5	559	263
Virginia....	260.2	80.2	417.8	405	292
N. Carolina.	275	111.5	477.5	384	491
S. Carolina.	43.8	98	110	294	820
Georgia.....	325	196.68	278	1,051	1,487.75
Florida.....	136.74	73.5	132	140	1,132
Alabama....	140.08	64.68	424.5	648	1,111
Mississippi.	168.5	43	67	597	454.7
Tennessee..	178.5	82	396	822	738
Kentucky..	175.25	52.5	213	247.5	651
Totals.....	1,756.52	802.06	2,802.3	5,147.5	7,450.45

Comparing these totals with those published with our last preceding map of this section, we have the following results at the dates named:

	Under Construction.	Under Survey.	Projected.
June 15, 1889.....	2,885	4,934	8,436
" 14, 1890.....	2,802.3	5,147.5	7,450

Thus it is seen that the mileage in process of construction, under survey, and projected with a fair promise of being constructed is less in all cases but one than it was one year ago. This present showing, while on its face less favorable than that of a year ago, is not in reality, however, so unfavorable as the figures would seem to indicate. This is especially true in respect to the prospective construction of the current year, the prospects being good for a greater mileage of track laid during the calendar year of 1890 than of 1889. Up to date nearly 300 miles more of track have been laid than was laid during the same period of the preceding year, and of the mileage under construction at the respective dates a greater proportion is now being actively pushed than at that time. In addition, a greater percentage of the work is being done by the larger companies, and fewer lines are being built upon the local aid of prospective "commercial centres." The same is true, only in a lesser degree, of the lines under survey and projected. Of the latter a large number are destined to enjoy but a short life, and, on the other hand, a smaller number, now in too chaotic a condition to be included in our list, will undoubtedly be carried to completion. Taken as a whole, the present prospects of railway construction are fully as good as they were a year ago. The rapid development of the mineral regions, and the consequent growth of the freight traffic of the existing roads, will prove an incentive to future construction, and, what is very likely to result, over-construction. It is to her mineral resources that the South owes her great progress in this class of enterprise as well as many others, but while her iron and coal industries will continue to enlarge they will never kill by competition the mineral industries of Pennsylvania and the North, much less those of England, as her admirers would make the people believe, and the quicker she comes to understand this the better. Railways can profitably be constructed in many portions of the south, and probably will be constructed, but no railway "booms" are wanted.

Taking up the various railway enterprises shown on our map somewhat in detail we find a considerable amount of activity in Virginia, North Carolina and Tennessee, especially in the western portion of the first two States and the eastern portion of the last. In Virginia the Atlantic & Danville Railway Co. completed a long stretch of track last year, and is now surveying for an extension to Bristol, Tenn., with the object of obtaining a short line from the seaboard at Portsmouth to the Cumberland mineral regions. The Clinch Valley Extension of the Norfolk & Western R.R. is being rapidly extended in the same direction and will probably have its line completed to a connection with the Cumberland Valley extension of the Louisville & Nashville R. R. this season. The South Atlantic & Ohio has already completed its extension to the same region, laying 21 miles of track this season. In the central-southern portion of the state the Roanoke & Southern and the Lynchburg & Durham railways are being rapidly constructed to furnish north and south connections between the Virginia and North Carolina railway systems. Of the other projected railways in Virginia, the greater number lie outside the limits of our map and were spoken of in connection with the map of that section published April 12.

A large number of projects is on foot in North Carolina. The Richmond & Danville and the Atlantic Coast Line railways are making several important extensions each in its respective territory. The Cape Fear & Yadkin Valley Railway which constructed a large portion of its extension from Fayetteville to Wilmington last year, has completed the line this season and is now pushing work on its line from Mt. Airy north to a connection with the Cripple Creek extension of the Norfolk & Western R. R., which is also under construction. A comparatively young enterprise is the Wilmington, Onslow & East Carolina R. R., being constructed from Wilmington northeast along the coast, penetrating a fine truck-farming region. In the western portion of the State the Charleston, Cincinnati & Chicago R. R. is by far the most important enterprise. This road is projected to run from Charleston northwest to the Ohio river, with a branch to Augusta, Ga. A portion of the line was built several years ago, and work is now being pushed on a large part of the remainder. The line will pass through the richest section of the Cumberland mineral region, and will furnish the mines of that section an outlet to Charleston. Three other lines now being built into this same section are the Asheville & Bristol, the French Broad Valley, and the Southern & Western Air Line. The two first are being built in the same interest.

Passing to Tennessee, we find that the seat of activity is in the mineral section of the eastern portion of the State, very little active work going on elsewhere, with one or two exceptions. The Tennessee Midland, whose line traverses the State lengthwise from Memphis to the Virginia line, is conservatively pushing work. In the east the Knoxville Southern is making rapid progress on its line from Knoxville south to a connection with the Marietta & North Georgia R. R. Construction has just been commenced on the Morristown & Cumberland Gap R. R., and the Nashville & Knoxville R. R. has completed 22 miles of track, and will probably build more this season. In addition a large number of short lines are being built by various land and mining companies to open up local regions, and by the large systems as mineral spurs.

South Carolina is showing far more activity than would be expected, active work being in progress on several important lines. The Seaboard Air Line has resumed construction on its line to Atlanta, Ga., and has laid a long stretch of track this year. Grading is now progressing on the remainder of the line and the close of the season will probably see it well on its way toward completion. The Columbia, Newberry & Laurens has laid 35 miles of track and is now extending its line to Newberry and Prosperity. The

Charleston, Sumter & Northern, formerly the Eutawville R. R., completed its line to Sumter last year and will soon commence work on the line from that place to Bennettsville. In the western part of the State the Carolina, Cumberland Gap, & Chicago and the Carolina, Knoxville & Western have lines projected from Augusta, Ga., and Edgefield, S. C., northwest to the mineral fields of the Cumberland Mountains. No work is now being done on these roads and probably will not be for some time to come, although there is a chance of its being resumed at any time. In the southeast the long talked of South Bound R. R. has assumed definite shape and work will probably soon commence on the line. This line will furnish the railway lines centering at Columbia with much needed connection with the seaboard at Savannah, Ga.

Georgia holds the first place in the mileage of railways constructed for the past 18 months, and will probably keep this position for a year or two to come, although she is being hard pushed by Alabama, North Carolina, and Tennessee. One of the most noticeable things shown by our map is the rapid growth of at least four of her cities as railway centers. Savannah, on the coast, has no less than five lines centering there, all running west and north to connections with the mineral lands of northern Alabama and eastern Tennessee. The Central R. R. of Georgia and the Savannah, Americus & Montgomery together have completed a line from Abbeville to Savannah, and the latter is now constructing an extension to Montgomery, Ala., which, when completed, will give an almost direct through line between the seaboard at Savannah and mineral lands around Birmingham, Ala. Of the other four lines, one is in the interest of the Macon Construction Co., which is building the Georgia Southern & Florida R. R., and its allied lines. Surveys are being made for this line. The Middle Georgia & Atlantic has completed 18 miles of its proposed line from Covington to Savannah, has about 20 miles more under construction and the surveys completed for the remainder. The Atlanta, Atlantic & Great Western has been on the *tapis* for a long time, but beyond making partial surveys, the company has done nothing. There is, however, a prospect of its being taken up at any time. Centering at Atlanta are the last two roads mentioned, the Seaboard Air Line's western extension, the projected Atlanta, Asheville & Baltimore and the Marietta & North Georgia, all coming from the north and east, and the projected Atlanta & Alabama from the west. Of the roads not before mentioned the Marietta & North Georgia is the only one upon which any work will probably be done this season. In the center of the State Macon is the junction point of the two branches of the Georgia Southern & Florida system and of the old, partly graded Macon & Dublin R. R., which has taken a new lease of life, and now seems in a fair way to be completed. The western branch of the Georgia Southern & Florida which is being built under the name of the Macon & Birmingham is being vigorously pushed, and will be completed at an early date. A city which has recently assumed a position as a railway center is Way Cross, in the southeastern portion of the State. Several roads are now projected from this point into the pine timber lands of southeastern Georgia.

Of the other enterprises of importance the Augusta & West Florida, projected from Augusta to Thomasville, has done a small amount of construction, and the prospects are good for further activity. In the northern part of the State several local enterprises are on foot, the most imporant of which are the Etowah Valley and the Dahlonega & Dawsonville railways, and in the west the Florida, Dawson and Northern R. R. and the Alabama, Georgia and Florida R. R. are projected to furnish Columbus a connection with the Gulf coast. Further north the extension of the Chattanooga, Rome & Columbus, from Carrolltown to Columbus, is again coming to the front together with a new enterprise, the Georgia, Tennessee & Alabama, projected to run from Talapoosa, which place an enthusiastic inhabitant describes as the "Italy of America and the coming Pittsburgh of the south," to Chattanooga, Tenn.

Only three roads of any great length are in process of construction in Alabama; the Montgomery extension of the Savannah, Americus & Montgomery, the Montgomery, Tuscaloosa & Memphis R.R., an extension of the Alabama Midland, and the Chattanooga Southern running from Chattanooga, Tenn., to Gadsden. All three of these are under active construction. The large number of short lines, however, bring the total mileage under construction well up to the largest figures, those of North Carolina. The principal part of the work is being done in the northern and mineral section of the State, the projected lines forming a veritable network in this region. Running north and south in the western part of the state the Gulf & Chicago R.R. has a line surveyed from Mobile to Sheffield. Contracts are reported let, but it is not probable that any great mileage will be built for some time to come.

Mississippi shows considerable activity for that State, several important lines being under way. In the South the Mobile, Jackson & Kansas City is developing slowly, and will probably be constructed. The Georgia Pacific and the Louisville, New Orleans & Texas have lines under construction through nearly the same region, and the Memphis & Atlantic has done a small amount of construction on its proposed line from Memphis to Columbus.

Of the other States, Florida is the only one which comes wholly within the limits of our map. Only two lines of any length are carrying on construction work, the Atlantic, Gulf & Havana and the West Florida & Alabama. On these roads grading is in progress in a slow way. Several short local roads are being built, but otherwise the activity is confined to various projected lines through the phosphate region in the western part of the State. In Kentucky the principal activity is in the northern portion outside the limits of this map. These lines were shown on our map of April 12, and described in connection therewith. Construction is in progress on the Paducah, Tennessee & Alabama R. R. between Paducah, Ky., and Paris, Tenn. Of the projected roads the Bowling Green & Northern and the Burkesville & Northwestern are most important.

Taking the construction as a whole, it is evident that the various lines are being built for the mineral traffic. Nearly all of the most important penetrate the mineral regions or form seaboard connections with roads which do. Some of these are wild cat schemes, as is but natural in a country where industrial enterprise is active, but a large number are being built to supply needed facilities and will, without doubt, prove paying enterprises.

The Master Car Builders' Convention.

The Master Car Builders' Association is a body of much more importance and much broader scope than its name alone would indicate. It might naturally be expected to be merely an association of practical car builders meeting to discuss shop practice and management and to compare experiences. Such it was in the beginning, and such, to too great a degree, the Master Mechanics' Association is still. But two great problems have intervened to give the "M. C. B" Association a broader scope.

The first of these is the necessity for regulating the constant interchange of freight cars, which is going on always on an enormous scale, by some system of equitable rules. Fifteen or twenty years ago intolerable confusion existed on this point, mitigated only by the native good sense of the officials, and even ten years ago practice was in a very inchoate and dubious condition. But by a process of yearly revision the dozen or so brief and blind "rules for interchange of freight cars," which were all that were first formulated, have been expanded into a series of 32 rules, which provide explicitly for almost every possible cause of doubt or dispute, specifying clearly what the duties of foreign roads are in regard to cars entrusted to them, and how much of the work they may do to keep these cars in running order may be lawfully charged back upon the home road, and how much they must bear themselves in default of having objected to the condition of the car when it was delivered to them.

The changes which may be made in these rules deeply affect the financial interests of every road which interchanges freight cars; and, as a consequence of this one fact, it chiefly happens that every road of any importance takes good care to be represented at the convention either by its Master Car Builder, or by some other of its officers, who is quick to detect the probable effect of any proposed change in the rules, and able to argue the points arising effectively and on short notice. To make this possible, it was provided some years ago that "representative members" might be appointed by any company having one vote for each 1,000 cars on its lines, the only qualification for his appointment being that he should have a "practical knowledge of car construction." As a consequence, superintendents, superintendents of motive power, mechanical engineers, and various others who never worked in a car shop in their lives are now not only full members, but among the most active members in its proceedings and discussions, speaking as they do in the name and by the authority of their company, whereas the non-representative member, who is such by virtue of his office as Master Car Builder only, speaks only for himself, and has but one vote, however many cars are under his charge. Of course, great numbers of the representative members are the Master Car Builders of their lines, but a considerable majority of the representative vote is cast by men who are not themselves car builders. What the M. C. B. Association really consists of, therefore, to a very large extent, is the ablest of the master car builders or other mechanical officers to be found on each line, and the effect is seen in its debates, which are spirited and intelligent.

The second cause which has added great importance to the work of the association is the work of establishing standards, a work which has become necessary from the same cause as the first, and we might even say made possible only by it, viz., the constant interchange of cars from road to road throughout the continent. With locomotives, uniformity of practice does not so much matter. Each road has its own standards, and uses them only at home, so that it matters not to it how good or bad its neighbor's locomotives may be. No doubt it would conduce greatly to good practice if the several roads would put their heads together about locomotives as they do about cars, and try to evolve from their united intelligence what was really the best form of locomotive for different kinds of service and conditions. Were they to do this the Master Mechanics' Association might immediately develop into a body of great importance; but as there is no necessity impelling to this, it is not even thought of, and as a consequence the debates of the Master Mechanics' Association are comparatively languid and slow, although it brings out and publishes yearly a most valuable collection of facts and reports in regard to locomotives, and is, of course, dealing with an intrinsically higher and more complex class of problems than the M. C. B. Association.

A third cause which adds importance to the con-

ventions of both these associations is that the gathering of so many technical officers of the railways of the country gives an excellent chance for displaying all new devices and inventions which are competing for favor, not only for cars and locomotives, but for track appliances and all kinds of miscellaneous appliances. Accordingly there is always a regular museum of exhibits displayed each year, among which are sure to be some of special interest and novelty.

This year has been no exception to the rule; and in fact the most interesting part of the convention was the "third house" exhibit, among which were two or three of very striking interest, as notably the exhibit of the Consolidated Car Heating Co., of Albany, N. Y., and of the Shoen Manufacturing Co., of Philadelphia, as to which we shall have more to say later.

As for the proceedings of the convention proper, this was an off year. The attendance was probably never before so large, but the subjects up for report and discussion were less important than usual, and the whole were less ably handled. The report on steam heating was a lamentably imperfect one. The real report on this subject, and the one which received by far the most consideration by the members attending, was the map and accompanying text in the last issue of this journal, which we may fairly say was received with universal interest and surprise. No inkling of the vast progress there shown to have been already made, amounting to no less than *one-quarter* of all the passenger train cars in the country, could be obtained from the committee's report, which is reproduced elsewhere, and which will be seen to be decidedly fragmentary, although having some good points. The discussion of the report was as lame and brief as the report itself, and thus little was done at this convention to advance or insure good practice in this, the most important, unsettled question in car construction.

As for automatic freight train brakes and automatic freight couplers, those great questions are already practically settled, and were not up for discussion in any form at this convention. The current advertisements of the companies manufacturing the Westinghouse brake and Janney coupler give the best evidence of this which has appeared since our brake and coupler map was published, Dec. 15, 1889, in their statements that since that date 80,000 cars have been equipped with air brakes, making a total of about 140,000, or 15 per cent. of the freight car equipment of the country, while of the Janney coupler (the only one for which we have the facts, and which we therefore specialize without prejudice to other makers), as many (within 2 per cent.) have been sold in five months as were sold in the whole twelve months of 1889. These are solid facts which speak for themselves, and show that the M. C. B. Association was well justified in leaving these once puzzling problems alone, as no longer problems.

Another great question on which a valuable report was reasonably expected, and will undoubtedly be had next year, was that on "Metal for Brake Shoes," of which committee Mr. GODFREY W. RHODES is Chairman. As our columns have recently borne witness, this committee has already done some most valuable and important work, but it has more yet to do, including most of its field work, and from the very completeness with which it proposes to cover the ground was unwilling to make more than an informal report this year, which was made verbally by the chairman, and which, informal as it was, was undoubtedly the greatest contribution to scientific knowledge made at the convention.

Of the reports we have left ourselves no space to speak in this issue. They were only four in all, and all except that on passenger car interchange rules, which resulted in adding a useful new body of rules, were comparatively unimportant.

CORRESPONDENCE.

The Late Moses Lane.

PITTSBURG, Pa., June 15, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR—I am glad to see a notice of MOSES LANE in ENGINEERING NEWS (May 17), for he was a noble man and a life long friend of mine. There are some little errors in the biography, which it may be worth while to correct, in order that they may not be perpetuated.

LANE graduated from the University of Vermont in 1845 (instead of 1844), and his first work was upon the Vermont Central Railroad. This is the way of it: My uncle, Governor PAINE, then President of the Vermont Central Railroad, was a trustee of the University, and attended the commencement exercises.

Parties were at that time being organized for the locating surveys and construction of the railroad, and he asked some of the professors if they had not some graduates who would like to enter the engineering corps. This resulted in his securing MOSES LANE, JACOB M. CLARK, now of Elizabeth, N. J., and Principal Assistant Engineer of the Central Railroad of New Jersey, and JOSEPH THOMAS DODGE, now Chief Engineer of the Montana Central Railway. After completing his division on the Vermont Central, LANE went to the Sullivan Railway with Mr. COLLINS CHESBROUGH, who had been Chief Engineer of the Vermont Central for a while. This led to his acquaintance with Mr. E. S. CHESBROUGH, who took him on to the Cochituate Water-Works, of which he was then in charge, where LANE gained the experience necessary to make him of great value to Mr. KIRKWOOD, on the Nassau Water Works. This is substantially the line of his development. Mr. JACOB M. CLARK was so perfectly intimate with LANE that he may remember the details of dates of these changes, if you care for them.

Whoever wrote the concluding paragraphs of your biography of LANE spoke accurately in describing him as a "lovable man, of spotless character and noble characteristics of heart and mind, and of childlike simplicity." I have never known a more perfect individual.

CHARLES PAINE.

Wellington's "Engineers' Field Book."

MONTICELLO, Mo., June 3, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Can you inform me when, if ever, there is any likelihood of Wellington's "Engineers' Field Book" being published, the publication of which was commenced in ENGINEERING NEWS some time ago, but the subject seems to have been lost. I would like to see the work published. I think there is need of such a work.

GEO. H. ROBERTS.

[Mr. Wellington authorizes us to say that he is not yet sure when, if ever, his announced field-book will actually see the light of day. The MS. is well advanced, and the tables well started; but various professional duties in addition to those of an editor of this journal have so occupied his time that he has been unable to do anything whatever to advance the book for three months past. No one can regret this more than he, or be more anxious to see the book published; but having occupied almost every night and Sunday for nine years, in getting out one book, he does not propose to do the same for another; but rather, to get it out at leisure or not at all, as the gods may will. ED. ENG. NEWS.]

Table for Computing Right of Way Areas.

SUPERIOR, Neb., May 23, 1890

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Herewith I send you a blue print of a table that I have calculated to facilitate the rapid and accurate computation of right of way on railroads. I have found it a great economizer of time and labor, and I send it to your valuable journal that it may be useful to others. It is calculated for a width of one hundred feet, the common width in the West, but a similar one can easily be calculated for any other width and in a very little while. The manner of using the table is as follows:

Acreage Table for Computing Right of Way. Width, 100 ft.

Stations.	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9		
												Feet.
0	0.000	0.023	0.046	0.069	0.092	0.115	0.138	0.161	0.184	0.207		
1	0.230	0.253	0.276	0.299	0.322	0.345	0.368	0.391	0.414	0.437	.01	.0023
2	0.460	0.483	0.506	0.529	0.552	0.575	0.598	0.621	0.644	0.667	.02	.0046
3	0.690	0.713	0.736	0.759	0.782	0.805	0.828	0.851	0.874	0.897	.03	.0069
4	0.920	0.943	0.966	0.989	1.012	1.035	1.058	1.081	1.104	1.127	.04	.0092
5	1.150	1.173	1.196	1.219	1.242	1.265	1.288	1.311	1.334	1.357	.05	.0115
6	1.380	1.403	1.426	1.449	1.472	1.495	1.518	1.541	1.564	1.587	.06	.0138
7	1.610	1.633	1.656	1.679	1.702	1.725	1.748	1.771	1.794	1.817	.07	.0161
8	1.840	1.863	1.886	1.909	1.932	1.955	1.978	2.001	2.024	2.047	.08	.0184
9	2.070	2.093	2.116	2.139	2.162	2.185	2.208	2.231	2.254	2.277	.09	.0207
10	2.300	2.323	2.346	2.369	2.392	2.415	2.438	2.461	2.484	2.507	.10	.0230
11	2.530	2.553	2.576	2.599	2.622	2.645	2.668	2.691	2.714	2.737		
12	2.760	2.783	2.806	2.829	2.852	2.875	2.898	2.921	2.944	2.967		
13	2.990	3.013	3.036	3.059	3.082	3.105	3.128	3.151	3.174	3.197		
14	3.220	3.243	3.266	3.289	3.312	3.335	3.358	3.381	3.404	3.427		
15	3.450	3.473	3.496	3.519	3.542	3.565	3.588	3.611	3.634	3.657		
16	3.680	3.703	3.726	3.749	3.772	3.795	3.818	3.841	3.864	3.887		
17	3.910	3.933	3.956	3.979	4.002	4.025	4.048	4.071	4.094	4.117		
18	4.140	4.163	4.186	4.209	4.232	4.255	4.278	4.301	4.324	4.347		
19	4.370	4.393	4.416	4.439	4.462	4.485	4.508	4.531	4.554	4.577		
20	4.600	4.623	4.646	4.669	4.692	4.715	4.738	4.761	4.784	4.807		
21	4.830	4.853	4.876	4.899	4.922	4.945	4.968	4.991	5.014	5.037		
22	5.060	5.083	5.106	5.129	5.152	5.175	5.198	5.221	5.244	5.267		
23	5.290	5.313	5.336	5.359	5.382	5.405	5.428	5.451	5.474	5.497		
24	5.320	5.543	5.566	5.589	5.612	5.635	5.658	5.681	5.704	5.727		
25	5.750	5.773	5.796	5.819	5.842	5.865	5.888	5.911	5.934	5.957		
26	5.980	6.003	6.026	6.049	6.072	6.095	6.118	6.141	6.164	6.187		
27	6.210	6.233	6.256	6.279	6.302	6.325	6.348	6.371	6.394	6.417		
28	6.440	6.463	6.486	6.509	6.532	6.555	6.578	6.601	6.624	6.647		
29	6.670	6.693	6.716	6.739	6.762	6.785	6.808	6.831	6.854	6.877		
30	6.900	6.923	6.946	6.969	6.992	7.015	7.038	7.061	7.084	7.107		

Having the distance between the boundaries of the tract through which the line passes, find the number of stations in the left hand column and in the column of tenths under .0 to 0.9 will be found the acres required, if the plus is an even ten feet. If the plus contains odd feet the correction to be added is found in the column of feet.

E. A. D. PARKER.

An American Railway Enterprise in Santo Domingo.

Comparatively few persons, either Americans or Europeans, have any idea of the value in soil and climate of the Dominican Republic. It may be regarded as a country favored by nature, but almost abandoned by man. The city of Santo Domingo was the cradle of the Spanish occupation of the Western Hemisphere. Here for years was centered the progress of which Columbus was the pioneer.

From 1500 to the middle of that century, that is until Mexico and Peru opened more enticing fields of enterprise, it was the beehive of the New World's activity. It is to-day replete with the souvenirs of the past. The old walls remain nearly intact with their numerous forts, bastions and sentry boxes, all of solid concrete and stone. There are the ruins of convents, churches, palaces, public and private edifices, many very picturesque from the tropical vegetation which hangs from them. In the beautiful cathedral repose the bones of the admiral and great discoverer, CHRISTOPHER COLUMBUS himself, while a modern statue of him adorns the plaza.

American enterprise has in the last year invaded this island in the form of a railroad, which is to start from the capital of the Republic, Santo Domingo City, and go first westward a distance of 25 miles to the town of San Cristobal. From there it is contemplated to push it on to Barri and Azua, and then later, by the Lake Eurequillo, to Port au Prince, the capital of the Republic of Hayti. It is known as the "Santo Domingo Shore Line R. R.," and the Concessionaire is Mr. OGDEN P. PELL, of New York. He was in Santo Domingo a year ago, and on April 25 inaugurated the work in person. Since then his interests have been looked after by Mr. NATHAN APPLETON, of Boston, who has just returned from Santo Domingo.

The engineer of the road is Mr. HENRI THOMASSEK, a Frenchman, chevalier of the Legion of Honor, who has resided for seven years in the Dominican Republic.

All Dominicans, from the President of the Republic, Gen. ULISES HENREAUX, down to the simplest

laborer, are greatly interested in the success of the undertaking, which seems destined to be of great value to the future of the nation.

Cost of Motive Power on French Canals.

According to *Wochenschrift des Oesterr. Ingenieur Vereines*, canal boats of 60 to 110 tons are towed by two men from 11 to 16 miles a day at a cost of 0.145 to 0.204 cents per ton-mile. This is only done in Middle France. Where a man and a horse are harnessed together from one to two miles a day more are covered, and the cost per ton-mile is 0.145 cents.

In Northern France it is practically obligatory to use horses in such service. Two animals can tow one loaded or two empty boats of 275 to 330 tons burden a distance of 9 to 20 miles a day. The price of such service varies considerably, ranging anywhere from 0.088 to 0.145 cents per ton-mile. The cost is always least when the horses are owned by the government.

A considerable traffic on the Seine is done by freight steamers of about 110 tons, which are paid 0.582 cents per ton-mile.

There are 8 "chain tows" in France on which the motive power is furnished by an engine in a small boat to which the canal boats are fastened. This engine pulls the tow by reeling in a chain laid along the bottom of the canal, the chain being paid out behind as fast as it is taken up in front. From 15 to 20 boats make up a tow, which will be pulled about 13 miles a day. Loaded boats pay 0.078 cents per ton-mile, empty boats nothing.

M. LEVY has been experimenting on the Canale St. Maur with endless cables running along each bank, and claims to have invented a very cheap system. As yet, however, no extended trials have been made.

Steel Plate and Malleable Iron in Car Construction.

The following important and interesting report was submitted by the committee of the Master Car Builders' Association on this subject, and is, perhaps, the most important new matter submitted at the convention:

STEEL PLATE AND MALLEABLE IRON IN CAR CONSTRUCTION.

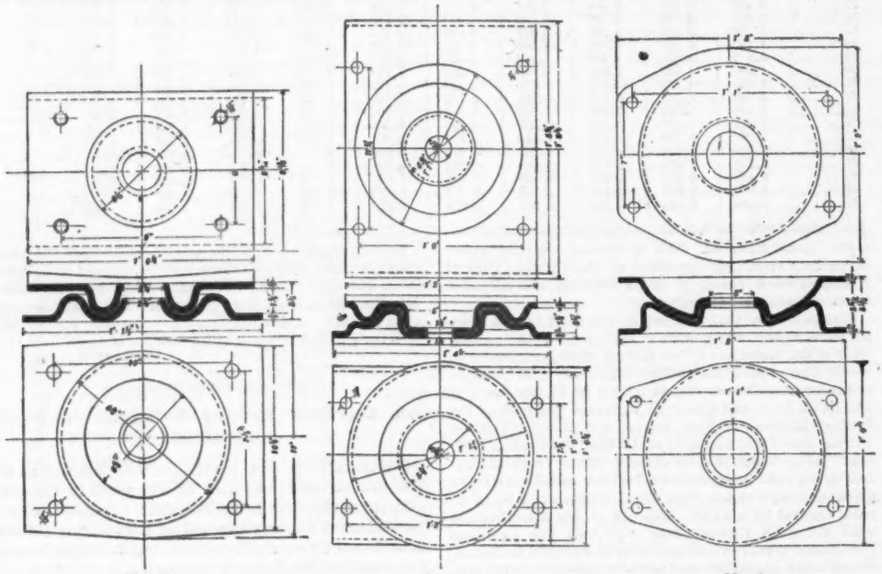
Pressed Steel.

The largest and most important plant in the United States for the manufacture of pressed steel forms for railroad equipment is the Fox Pressed Steel works at Joliet. This concern is working under the direction of Mr. SAMSON FOX, of Leeds, England, inventor of the Fox corrugated boiler flue.

It was in connection with the flanging of these flues that Mr. Fox gave his attention to the system of hydraulic pressing, which led him to the invention of flanged forms for use in locomotive and car construction. These forms are produced complete at one heat, with facing strips for the attachment of necessary fittings; and with sufficient rigidity in all directions so as to dispense with the use of angle irons. The regular practice at present in car work, especially in the manufacture of trucks, is to rivet and bolt together pieces of cast-iron and wood. Fox's flanged frames are in one piece, and they must possess a superior strength and endurance in service, as compared with built up frames. The quality of the metal is tested in each production, for if it did not possess strength and ductility in a high degree, it would not endure the severe stress due to the process of pressing. The metal used is open-hearth steel having a tensile strength of 50,000 to 55,000 lbs. per sq. in., and an elongation of 25% in 4 ins. The plates are heated to a bright yellow color, and formed under hydraulic presses working at a pressure of 850 lbs. per sq. in.

The product of the Fox Pressed Steel Co. is familiar to you all. A good example of a truck side frame was exhibited at Alexandria Bay in 1888. Pressed steel center plates made by this company are now in service in large quantities on 12 or 15 different lines. The weight of the plates thus replaced is reduced to less than one-third the weight of castings, and the tensile strength per square inch of the material used is three or four times as great, while the ductility of the steel plate renders it practically indestructible, and makes it particularly well adapted to resist the severe shocks to which center plates are subjected.

On account of the expense and delay in making dies, as well as the matter of interchange repairs, it is desirable that a few standard forms for pressed steel center plates be selected and recognized as standards by the Association. We therefore present several different types of sufficient variety in design to meet the wants of most members, and they are shown in Nos. 154, 172 and 6 of the Fox Co. and No. 5 of the Schoen Co.



No. 154. No. 172. No. 6.

Center Plates: Fox Solid Pressed Steel Co.

The catalogue of the Fox Steel Co. exhibits the application of their process to complete freight and passenger trucks and complete steel cars.

The pressed steel freight truck, Class D, designed to replace the ordinary diamond truck, weighs 4,600 lbs., as compared with about 5,000 lbs. for the latter, and the cost of the steel trucks is very little more than the diamond form. Class L is another form of pressed steel freight truck, in which pedestals are used to relieve the frame from the severe shocks experienced in the diamond form, where the journal box is rigid to the frame. In this design springs are placed on the side frames, and the load is transmitted to the journals by the introduction of equalizers. This truck weighs only 5,200 lbs., or 200 lbs. more than a diamond truck, but its action on the track, as well as its effect on the motion of the car body, must be nearly equal to that of a regular passenger truck.

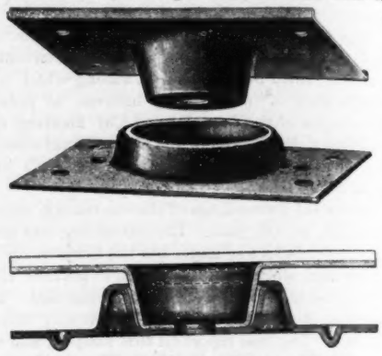
The Schoen Manufacturing Co., of Philadelphia, have been making pressed steel stake pockets and center plates for several years, and they have their center plates on 7,000 cars. They are now making a pressed steel draw-bar attachment, which is already in use on nearly 2,000 cars. They are also making a pressed steel brake beam. Mr. Schoen has designed a steel gondola car weighing only 18,000 lbs. having a capacity of 60,000 lbs.

The Schoen Co. is erecting a plant in Pittsburg for their steel specialties for cars, and they expect to commence work this fall. We give illustrations of their center plate No. 5, drawbar attachment, and stake pockets.

The Michigan Railway Supply Co., of Detroit, makes a pressed steel brake beam called the "Central Steel Brake Beam," which is already used to a considerable extent. The same company manufacture a grain door for box cars made of thin steel plate, and it is now in successful use on several hundred cars on the Michigan Central Railroad. The cost of the pressed steel door is about the same as that of wooden doors with their fixtures. We present illustrations of these two specialties of the Detroit Company.

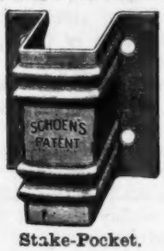
Malleable Castings.

Our investigations as to the "Use of Malleable Iron in Car Construction," through communication with the manufacturers of the material and the manufacturing car builders would indicate that its use is by no means limited, and that it is extending rapidly. Its use is confined principally to those parts formerly made of gray iron, but in some instances it is substituted for wrought iron, as will be observed in the attached list of parts now being successfully produced by the manufacturers.

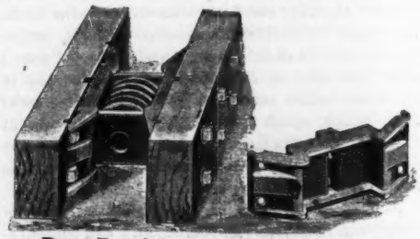


Center Plate No. 5; Schoen Manufacturing Co.

The advantages of malleable castings over the gray iron are greater strength, lightness and durability. Wherever a part is subject to shocks or stresses other than those of compression, the value of malleable castings becomes apparent. The tensile strength of good malleable iron of proper designs is about four-fifths that of wrought iron, such as used in car construction. The facility with which a casting, with many of the properties of wrought iron, can be made, renders its substitution desirable for parts where forgings are expensive or impracticable. That this is appreciated by our designers is shown by its extensive and increasing use in the small parts of cars as shown in the appended list. A reduction in the weight of the parts used in the construction of cars could certainly be obtained by the more extensive use of malleable iron castings. The claims of the manufacturers and users would indicate that, generally, a gray iron casting can be reproduced in malleable at about three-fifths the weight of the gray iron.



Stake-Pocket.



Draw-Bar Attachment; Schoen Manufacturing Co.

Taking the weight of castings now used in a 60,000-lb. car, say at 3,500 lbs., the reduction in dead weight would be 1,400 lbs. per car by the substitution of malleable iron. The durability of the material on account of its greater strength will commend it to those appreciating the cost of loss of service of cars on account of repairs to broken parts, to say nothing of the direct outlay of the renewal. The advantages of strength, lightness, and durability being apparent, the question of cost arises.

Manufacturers state that for large orders for the building of cars where the malleable iron would be used throughout, it could be produced and sold for 3 cts., or

perhaps under that figure, per pound. Taking our weights of castings as above, the comparative cost would be per 60,000-lb. car as follows:

3,500 lbs. cast iron at $1.80 ..... $63
3,500 lbs. — 1,400 lbs. = 2,100 lbs. malleable iron at 3 cts. 63

Malleable iron scrap, however, is not so valuable as cast scrap, being about as follows, varying with the market:

Cast scrap, per ton, net $15.00
Malleable scrap, per ton, net 10.00

Malleable iron, though, would greatly reduce the amount of scrap produced, so this question loses most of its weight. All the makers of the M. C. B. type of coupler have adopted malleable iron as the most durable and economical metal.

The strength of malleable iron castings depends very much upon the proper proportion in designing the pattern. The following rules may, therefore, be of advantage to draughtsmen:

1. Never run abruptly from a heavy to a light section.

2. As the strength of malleable iron lies in the skin, expose as much surface as possible. A star-shaped section is the strongest possible form in which a casting can be made. For brackets use a number of thin ribs instead of one thick one.

3. Avoid all round sections; practice has demonstrated this to be the weakest form. Avoid sharp angles.

4. Shrinkage, generally, on castings will be 3-64 in. to the foot smaller than the pattern.

The following is a list of malleable castings now made for freight cars:

Brake wheels,
Brake wheel ratchets,
Brake beam fulcrums,
Brake lever jaws,
Brake heads,
Body queen posts,
Car door fastenings, various kinds,
Center plates, truck, various styles,
Corner plates,
Drawbar stops,
Door handles,
Janney, uncoupling castings,
Label holders,
Lower swing hanger pivots, for swing beam trucks.
Web, or truck end castings,
Brake wheel hangers,
Brake pawls,
Brake beam hangers and clevis,
Brake hanger carrier,
Brake shoes,
Car door trimmings, various kinds,
Center plates, body, various styles,
Covers, journal box,
Drawbars, various kinds,
Dead blocks,
Door shoes,
Journal bearing keys,
Lantern brackets,
Spring plates, all types,
Stake pockets,
Washers, various kinds.

Conclusion.

The subject of this report is a general one, not accompanied by any specific instructions. We have therefore treated it in a general way, and the only matter requiring any action of the Association is in the direction of standard forms for various details made of pressed steel.

The diversity of shapes and sizes for pressed steel center plates and stake pockets is now almost as great as that for cast-iron ones, and the subject should be further considered by a committee on "standards," so that these and other pressed steel details may be reduced to a few standard forms.

In conclusion, we desire to emphasize the following facts: First: That malleable iron castings possessing strength and durability far superior to cast iron and weighing considerably less per car, can, by reason of reduced weight, be purchased at about the same cost per car. Second: That the price of iron and steel beams, channels and plates is now low enough to make it possible to construct a flat, box or coal car of greater strength and durability of equal weight, at a cost very little in excess of a wooden car. Third: The use of pressed steel makes it possible to construct steel cars with few parts and with shapes or forms especially designed and adapted for car construction, of a material possessing the greatest strength for a given weight. For these reasons we believe that the extensive use of malleable iron and steel in the details of wooden cars will result in the gradual disappearance of wood, and we expect in a few years that iron or steel under frames and plate steel trucks will be generally introduced in the United States.

Committee: WM. FORSYTH, Chairman; JOHN MACKENZIE, E. D. BRONNER.

AURORA, Ill., May 10, 1890.

Steam Heating and Ventilation of Passenger Cars.

REPORT OF COMMITTEE OF THE MASTER CAR BUILDERS' ASSOCIATION.

Your committee, appointed to report to the Association on the subject of Steam Heating and Ventilation of Passenger Cars, begs to present the following:

A circular was forwarded to members of the Association, and from replies thereto the following information and data have been collected.

The information, as far as practicable, has been put into tabular form in the attached statement.

The information gathered from the reports, and which could not be tabulated, is as follows:

The devices used for regulating temperature are in general shut-off valves of various kinds by which the flow of steam is controlled.

The Johnson automatic regulator is used by the B. & O. Ry. and the C., M. & St. P. Ry. with very satisfactory results. The N. Y., L. E. & W. Ry. uses an attachment invented by J. E. Sagne, which regulates the flow of steam to radiators as desired. The D. & H. C. Co. uses a dial cock which shows amount of steam opening.

As to the comparative merits of direct and indirect steam heat (the term indirect meaning that the steam is utilized for heating water which heats the car), the general opinion seems to be as follows:

1. Direct steam heats up cars in a shorter time than indirect.
2. Direct steam requires a lower pressure in main pipe.
3. Indirect steam gives a milder heat.
4. Indirect steam heat is less liable to fluctuations.
5. The use of indirect steam necessitates careful attention when cars are out of service to prevent the water in pipes from freezing.

As to the relative merits of inside and outside main steam pipes, all reports show that the main steam pipes are placed outside and beneath the cars with the exception of the C., M. & St. P. Ry. On that road the main steam pipe and connections are placed overhead and inside the cars. The advantages claimed for it being that by this arrangement a more direct communication is effected, the pipes can be so arranged that there is a positive fall of water of condensation from the main pipe and all radiators to the trap, and all pockets for water can be avoided.

The data obtained as to consumption of fuel are somewhat meagre.

Tests by the Delaware & Hudson Canal Co. show with the Commingler system that an average of 49 lbs. of water per car per hour maintained the temperature inside the car 33° higher than the outside temperature, and the temperature of the discharged water was 134°.

Tests on the Chicago, Milwaukee & St. Paul R. R. show as follows:

Outside temperature.	Inside temperature.	Water of condensation per car per hour.
40°	70°	70 lbs.
30°	70°	85 lbs.
10°	70°	100 lbs.

These figures agree quite closely with the results obtained from some tests made on the Old Colony Ry. by Prof. LANZA for the Massachusetts Railroad Commissioners.

All reports indicate that hose connections are used exclusively. The Baltimore & Ohio, and the Chicago, Milwaukee & St. Paul railways report using the Gibbs coupling. No reports as to the couplings used by the other roads.

The provisions made for heating up cars in yards consist almost entirely in utilizing some stationary steam producing plant. Car stoves are also used, the fires being removed when cars are placed in service.

In all cases the necessary heat when the steam system becomes inoperative is obtained by starting fire in stoves.

In the matter of independent cars for heating trains, the only road reporting such cars is the C., M. & St. P. Ry. Two such cars are in service on this road, and furnish steam for heating the train and operating the electric light. When steam is furnished for both heat and electric light, it is believed that it costs no more to haul the extra car than it does to furnish steam from the locomotive.

No special means of ventilation is in general use. The Union Pacific R. and L. S. & M. S. R. report using the "Creamer"; the Central Vermont R. R. the Globe, Carroll and Creamer; the C., M. & St. P. R. use on some cars a boxed steam coil at the end of the cars through which air is forced by the pear Heater attachments used in connection with the stove for this purpose, and the improvement as to the condition of the air is very decided.

As to failures, all reports concur in claiming that none occur if all points are properly cared for by the attendants.

The above covers the information which has been obtained from the replies to the Circular of Inquiry. It is to be regretted that so small a number of replies has been received, the difficulty very likely being that practice in the matter of steam heating is changing, many modifications are being made as experience points out the way to improved results, and many therefore feel that they have little definite to say that is thoroughly grounded on experience

J. N. BARR, T. A. BISSELL, J. W. MARDEN, J. C. BARBER, W. H. LEWIS, committee.

TABULATED INFORMATION ON STEAM HEATING. [M. C. B. COMMITTEE REPORT.]

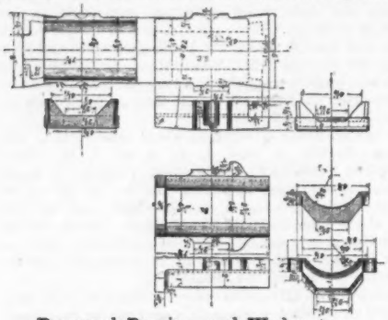
NAME OF ROAD.	System used.	Direct or indirect.	No. of cars.	No. of months in use.	Largest trains.	Average time to heat up cars.	Pressure registered in pounds with varying train and outside temperature.			Pipes.			Outside temperature.		Temperature in car.	Time and pressure to effect circulation, indirect.		Noticeable effect on locomotives.
							Pressure in Pounds.	Temperature.	Cars in train.	Diameter.	Length.	Radiating Surface.	Average.	Lowest.		Time.	Pressure.	
						Min.	Lbs.	Deg.		In.	Ft.	Ft.	Deg.	Deg.	Deg.	Min.	Lbs.	
Baltimore & Ohio	B. & O., No. 1.		77	18	6	60	15			2		138			70			
	" " 2.		11	12								119						
	" " 3.		3	12								124	10					
	Martin	D	3	5									to					None.
	W'house ret'n		4	16									20					
	McElroy	I.	3	15												17	35	
	Martin	I.	3	6												95	35	
	N. Y. Safety.	I.	3	6												25	37	
Lehigh Valley R.R.	Lehigh Valley	D	240	....	14	25	25			2	250	....	28 to 30	....	60 to 70	40 to 60	....	Little if any.
Union Pacific R'y	Martin	D	33	4	3	45	5 to 10			2	....	185	10					Little if any.
N. Y., L. E. Western	N. Y., L. E. & W	D	529	....	14	45								-8	70			
	N. Y. Safety	I.	40	....			15									30		
	Martin	I.	1	....			to									to		None.
	McElroy	I.	1	....			40									60		
	Baker C'bine		1															
Lake Shore & Mich. So	Martin	D	138	....	15	15	15			2	200				70			
	McElroy	I	17	....		60	40			1¼	380					45		No data.
Del. & Hud. Canal Co.	McElroy	I	124	36	12	60	20			1¼	333	146	0	-42	65 to 70	10 to 15		None.
	Consolidated																	
	Commingl'r Co	D	Some															
Central Vermont	Consolidated	D	16	24	8	30	15			1½	....	150	45	-25	70 to 80			None.
	Commingl'r Co																	
Lake Erie & St. Louis	Timmler	D	20	36	6	30	3			1¼	300	....	32	-5	70	40 to 60		None.
	Heidinger																	
Chicago, Milwaukee & St. Paul	C., M. & St. P.	D	158	...	6	60	5	30		2	...	191		-45	70			
							10	0										
							20	-15										
							30	-30										
	N. Y. Safety	I	3													30	25	
Wis. Cen. Lines	Martin	D	10	12	5	25	5			2	....	170		-25	70			None.
Wagner Palace Car Co.	McElroy	I	252	24	..	25	10 to 15			1¼	....	160	10	-15	65 to 70	15 to 20		
	N. Y. Safety	I	23	6	..	45	30			1¼	....	160						
Fitchburg R. R.	Consolidated	D	228	36	13	10 to 30	15			1½	350	150			70	15 to 30		None.

Standard Journal Box Bearing and Lid for 60,000-lb. Cars.

The accompanying drawings show proposed standards submitted on the last day of the M. C. B. Convention, and now to be voted on by letter ballot. The report of the committee in full is as follows:

PROPOSED STANDARD JOURNAL BOX, BEARING AND LID FOR 60,000-LB. CARS, AND LID FOR OLD STANDARD JOURNAL BOX.

The committee respectfully submit for your consideration and adoption the designs herewith of a proposed journal box, bearing and lid for 60,000 lb. cars in which the Fletcher lid may be either of malleable iron or pressed



Proposed Bearing and Wedge for 60,000-lb. Car.

steel, as shown. The committee finds it advisable to make a larger journal box than the present standard, and it recommends the change shown in the wedge and brass for the new journal box, because this construction gives a full bearing of the wedge upon the brass, and is less liable to deform the brass when it becomes worn thin than in the old practice of concentrating the load upon the middle of the brass. The necessary clearance for rocking motion is provided between the wedge and the top of the journal box instead of between the wedge and the brass, and the wedge must be of such strength as will serve to distribute the load evenly over the whole length of its bearing upon the back of the brass. This enlarged journal box has the opening for the lid maintained at such dimensions as would permit the use of the same lid on the new and the old boxes by a slight modification in the opening of the present standard journal box.

The committee therefore submits also a design showing the same lid, whether made of malleable iron or pressed steel, adapted to the present standard journal box, and recommends its adoption as standard for that box. No changes are made in this standard journal box except in the opening, which has heretofore been incomplete on account of no means being shown for attachment of lid, and which the committee proposes to complete in such manner as will permit the use of the same lid as herein proposed for the new standard journal box for 60,000 lb. cars. JOHN S. LENTZ, F. D. CASSANAVE, R. MCKENNA, J. N. LANDER, A. A. JACKSON, Committee.

Storage Battery or Accumulator Traction in England.

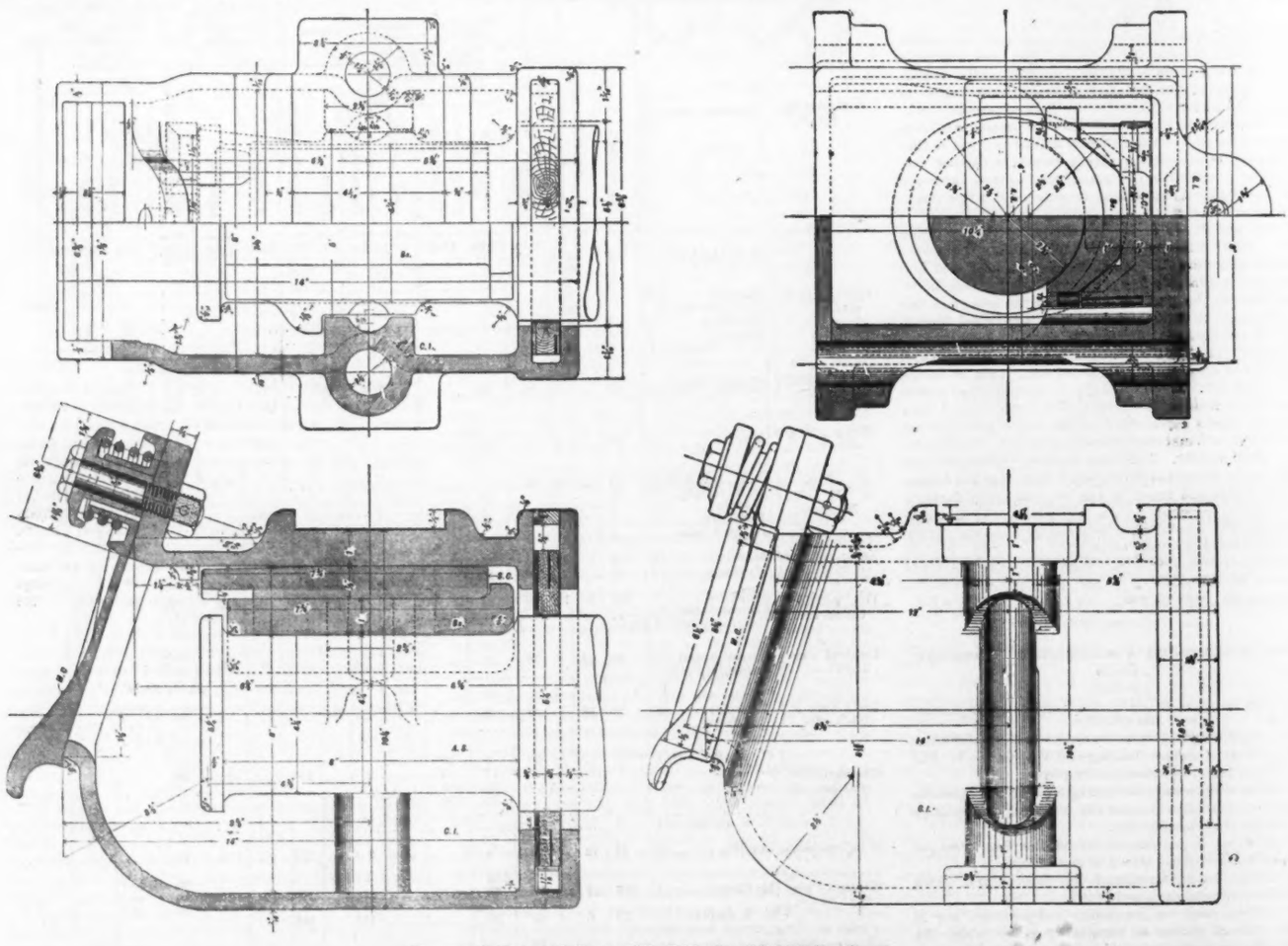
[FROM A LONDON CORRESPONDENT.]

Some time ago the English Board of Trade issued regulations prohibiting the employment of overhead electric light conductors except in special cases, for which permission must be obtained. It is for this reason that but two systems of electric traction are possible for urban and suburban traffic in England; but there are several varieties of these. The two systems are the underground conductor system and the accumulator car method. In the first mentioned system very little has been done except experimentally, but with the second six cars have for a year been worked successfully from an operating point of view on the Barking section of the North Metropolitan Tramway Co. The cars are worked by the Electric Traction Co. at 9 cts. per car mile, but from a financial point of view they have not been a success, owing principally to the fact that the cars are run in poor districts and but few passengers, comparatively speaking, are usually carried. Otherwise, if more passengers were conveyed, the line would be a commercial success.

A new system, and one which seems to have a great chance of success, is now being tried on the Tooting-Clapham Westminster Bridge section of the London Tramways Co., who have altogether 21¼ miles of tramway track in the metropolis. The system is the Jarman accummulator car method, which is being developed by the Electric Tramcar Syndicate. As the system is entirely new and exceedingly ingenious, the following detailed description will be of interest.

The first car has commenced running and five more will soon be added. The contract price is nine cents per car mile, or two cents less than the average cost of working horse cars throughout the tramway company's system.

The car presents the same appearance as an ordinary horse-car, and carries 44 passengers, 20 inside and 24 outside. The batteries, which are of the double E type, are 52 in number, and are placed underneath the seats on rails, and are accessible from either end and side of the car by means of flap doors. By this means efficient ventilation is insured, and the possibility of explosive gas accumulating, removed. The cells are arranged 26 under each row of seats and are connected in series. The electromotive force is 208 volts and the current 60 ampères. The motor is of the Jarman compound type and is attached to a steel frame bolted to the car body and supported entirely by the car axles through the axle boxes. The principal feature of this motor is the employment of two armatures on one spindle, and two bi-pole field magnets. The object of this double or compound motor is the arrangement of two motors in such a manner that the "torque" or magnetic twist may be increased in inverse ratio to the speed rate, or *vice versa*; or the operative parts may be divided so as to allow one part to be electrically inactive whilst the other part is performing work and absorbing mechanical energy, the regulation being effected by varying the winding of the magnets, so



Proposed Journal Box with Lid, for 60,000-lb. Cars.

as to alter the electrical conditions relatively to the working current. The method of winding the field magnets is termed the "gamut" winding. This consists in the winding of the magnets with layers of wire of varying resistances which may be either cut out or included in the circuit by means of a suitable switch, when it is necessary to increase or reduce the current by varying the total resistance. The ends of each layer of wire are led to the contacts on the switch, so that each or all of them may be cut out or included.

The gearing by which the motive power is transmitted to the wheels consists of a single set of mortice wheels and pinions. The motor has fitted on its axle a wrought-iron pinion placed near the center of the motor spindle. This pinion engages with a mortice wheel carried on a countershaft, which has fitted on it also a pinion, which gears with a second mortice wheel arranged on the front axle of the car. The normal speed of the motor is 650 revolutions, of the countershaft 216 revolutions, and of the front axle, 90 revolutions per minute.

These mortice wheels are made of cast-iron, with flanges cast upon each side of the rim, but in future cars they will be made of phosphor bronze, so as to reduce the weight. The teeth or cogs are made of vulcanized fibre, and are fitted and driven into the slots formed within the rim of the wheel for the purpose; but instead of the shanks being pinned upon the inside of the rim, a hole is drilled through both flanges just upon the pitch line, and a pin is driven through, thus firmly securing the cog to the wheel. By this means the strain upon the cog by the working load is transmitted directly to the rim of the wheel, and the shank of the cog is thereby relieved of the greater part of the strain. These teeth are easily replaced, and render the running of the car almost noiseless.

On the rear and front platforms is arranged a switch case about 36 ins. high by 7½ ins. in diameter, and a vertical lever brake. The brake is double, being arranged both on the motor spindle and on the car wheels. The adoption of this double brake places the car more under the control of the driver. The switch in the case is a wooden cylinder, mounted upon a metallic spindle within bearings, so that the switch may be fully revolved by a handle. The cylinder has on its outer circumferential surface several strips or rings of gun metal which are sufficiently wide to electrically connect any pair of a number of contact tongues which represent the various ends coming from the field magnets. The strips or rings are also formed of various lengths corresponding to the part of a revolution of the switch handle, at which contact is to be made between any pair of tongues, and also to be maintained whilst other layers are placed in series or in parallel with those already included in the circuit. Several plugs are placed in such a position upon the surface of the cylinder as to establish electrical contact between the spindle or with a suitable ring on the cylinder and the tongue connected with the termination of the last layer that has been placed in circuit, a suitable connection being provided to couple the spindle or ring to the brush or other part of the circuit, so as to complete it. A rounded projection upon the lower side of each tongue enables contact to be made either with one of the strips or one of the plugs, the tongues being sufficiently elastic to establish a good temporary contact without vibration or undue resistance between the points thereof. The number of strips and plugs correspond to the number of layers on the "gamut" winding, for working the motor singly, in series or in parallel. The case has at its top a switch handle for rotating the cylinder, and driving directions in figures are cut out of the metal cover. At normal speed only one armature is performing the work, while the other is revolving idly, and at full speed the compound motor is in parallel.

The cells are charged in parallel at the depot, and the time occupied is about five hours. The writer has made several runs on the car with a full load of passengers. With the motors in series (half speed of 8 miles an hour), the energy required on a level track was only two ampères, and with the motors in parallel (full speed of 16 miles an hour), only 44 ampères. It is too early to speak with certainty of this system, but so far as known, in no part of the world where accumulator cars have been tried has such a low consumption of energy, combined with a high speed, been known. These results are obtained solely by the special system employed, which is patented. The practical working of the system is being looked forward to with great interest.

Experiments as to "Imperceptible Slip" of Locomotive Drivers.

We are indebted to Mr. F. W. SARGENT, Engineer of Tests, Chicago, Burlington & Quincy R. R., for the following interesting confirmatory evidence that the alleged phenomenon called imperceptible slip of locomotive drivers does not and cannot occur in practice under anything approaching ordinary working conditions. The records are explained in an accompanying letter as follows:

I inclose you some figures taken in connection with dynamometer car work with a couple of engines in 1889. I notice an account in the "Economic Theory of the Location of Railways" pertaining to the slip of drivers, the French records of alleged imperceptible slip being given, and your own opinion to the contrary. I rigged a contact circuit breaker on the guide of the engine, and had it register each revolution on the dynamometer paper. I have run several hundred miles behind our class H, I, A and D engines, and have not found the slightest indication of a slip, except at starting, and when brakes are on, at point of stopping, when the wheels slid. While working steam at speeds from 5 to 60 miles per hour up and down hill, the figures given herewith were repeated, and so far as our counter was concerned there was no sign of slip. While this is not new it is possibly satisfactory to you to know our experience corroborates your ideas:

TESTS SHOWING NON-EXISTENCE OF IMPERCEPTIBLE SLIP OF DRIVING WHEELS IN MOTION, C., B. & Q. R. R.

Engine No. 128, Class "H," Passenger Mogul, 19 × 24 cylinders, 91,500 lbs. on drivers; diameter of drivers, 66⅛ ins.

Obs. No.	Time. Seconds.	Distance. Miles.	Speed. Average M. P. H.	Speed varied From	Speed varied To	Revolutions of drivers. Actual.	Revolutions of drivers. Theoretical.	Approx. pull.	Grade.
1	62	1	58	60	55	303 ×	303.3	1,100 lbs.	— 5.28 ft. per mile.
2	61½	1	58⅔	57	60	303	"	1,200 "	— 30 ft. per mile.
3	61⅔	1	58⅓	57	61	304	"	1,300 "	— 28 ft. per mile.
4	78	1	46.4	43	49	303	"	2,000 "	— 28 ft. and 8 ft. per mile.
5	103½	1	35	30	42	303	"	3,300 "	— 28 ft. and + 28 ft. per mile.
6	135	1	26⅔	19	30	303	"	4,100 "	+ 30 and + 15 ft. per mile.
7	39	½	30.5	27	35	152	151.6	5,000 "	+ 30 ft. per mile.

Special Engine No. 139, American type, 15 × 22 cylinders, 48,400 lbs. on drivers; diameter of drivers = 62¼ ins.: weight on drivers =

Obs. No.	Time. Seconds.	Distance. Miles.	Speed. Average M. P. H.	Speed varied From	Speed varied To	Revolutions of drivers. Actual.	Revolutions of drivers. Calcul'd.	Approx. pull.	Grade.
1	110	1	32¾	20	38	321 +	321.7	1,750 lbs.	{ — 0 to — 40 feet per mile. { + 0 to + 40 ft. per mile.
2	93	1	38¾	39	37	321 +	"	1,500 "	+ 0 to 40
3	112	1	32	28	38	321 +	"	2,500 "	0 to — 53.
4	89	1	40½	40¼	40¾	321 +	"	1,000 "	0 to + 28 and 0 to — 1.0.
5	71	½	2 ½	18	32	161	160.9	2,250 "	0 to — 15.
6	134	1	27	25	31	322	321.7	2,750 "	+ 30 to + 92.
7	90	½	20	11	29	161	160.9	5,100 "	0 to + 25.
8	97	1	37	37	37	321	321.7	1,800 "	0 to — 48 and 0 to + 80.
9	64	½	28	21	31	160 —	160.9	2,800 "	0 to + 53.
10	163	1	22	21½	22½	322	321.7	2,600 "	+ 90, + 53, + 25, + 0.

What the phenomenon is which has been christened "imperceptible slip," and which is still frequently referred to in foreign literature as an actual phenomenon, we have briefly noted editorially.

To Find a Leak in an Underground Pipe.

A German paper thus describes a method of detecting leaks in underground gas-pipes: Test holes are sunk in the ground along the lines of the gas mains, and ¾-in. wrought-iron pipes about 3 ft. long are inserted. In the upper ends of these pipes small glass tubes are placed, each tube containing a slip of paper moistened with chloride of palladium. The test papers turn black under the influence of illuminating gas, the rapidity and distinctness of the reaction depending upon the strength of the palladium solution and upon the volume of escaping gas. Under the most unfavorable conditions, however, an exposure of the test paper for a period of 15 min. is considered long enough to show whether or no gas is present. The test holes should be placed about 6 ft. apart, and should not reach below the line of gas pipe. The main object is to penetrate the more or less compact surface material of the street, so that the gas in the ground has a direct and convenient means of escape. In many of the streets of Frankfort-on-the-Main, especially those having asphalt pavement, 1-in. pipes lead through the asphalt and the underlying layer of beton, their lower ends extending to within a short distance of the gas mains. These escape pipes are filled with pieces of sponge, and are closed with cork stoppers. The pieces of sponge are renewed from time to time. The pipes have been found to overcome, to a considerable extent, the annoyance of digging up the streets for long stretches with the view of locating leaks in the main.—*Exchange.*

The Highways of the Grand Duchy of Hesse.

In the Grand Duchy of Hesse all roads which lead from one town to another, to a railway station, to a navigable river, or to the boundaries, as long as they do not form a part of the ducal highways, are maintained by the different circuits through which they pass. These circuits are something like our counties. The cost of the maintenance is borne equally by the circuit and the province in which it lies.

In making a new road, the duchy furnishes one-fourth of the necessary amount (exclusive of the price of the land), the town in which the road is to be built furnishes another quarter and the remainder is paid equally by the circuit and the province. The different villages pay for the land and the roads connecting the old and the new highways. The improvements to be made are selected by the provincial council. In each of the three provinces of the grand duchy is an engineer and an assistant engineer, whose duty it is to confer with the overseers of the roads and see that the repairs are properly made as well as to plan the new highways.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

New York Central & Hudson River.—The directors of this company have authorized the issue of $15,000,000 of bonds, the proceeds to be used in making necessary improvements to the roadbed and rolling stock. The greater portion will be used for the depression of the tracks in the annexed district, and those of the Port Morris division of the Harlem R. R., including the elevation of the Harlem bridge; the laying of a third track from Sing Sing to Spuyten Duyvil; the depression and elevation of the tracks to avoid grade crossings, and the various terminal improvements contemplated at Buffalo, N. Y. A large amount of new rolling stock will also be added to the equipment.

Ulster & Delaware.—It is stated that the Vanderbilt interests in the West Shore R. R., together with the Delaware & Hudson Canal Co., have secured control of this railway running from Rondout to Stamford, N. Y., with an extension to Hobart. Under the new management the extension from Stamford to Oneonta, N. Y., where connection will be made with the Delaware & Hudson Canal Co.'s lines will be built at once. The new acquisition will give the New York Central & Hudson River and the West Shore railways a through line to the Katskill Mountains and to Cooperstown and Richfield Springs.

Lehigh & Hudson River.—A meeting of the officials of this company, the Lehigh Coal & Navigation Co., and the Central R. R. Co. of New Jersey was recently held to consider the reduction of the grades on the L. & H. R. R. R. which connects the other two roads with the Poughkeepsie Bridge system. It was decided to make a heavy cut in the grades of the Lehigh & Hudson River road at three points, namely, near Belvidere and at Townsbury and New Milford. The reduction will be from a maxi

mum of 53 ft. to the mile to a minimum of 37 ft. to the mile.

Lehigh Valley.—Civil Engineer John G. Tait, who has charge of the surveys for the proposed extension to Philadelphia, Pa., is quoted as follows:

"The Lehigh Valley Railroad Co. has been making surveys for a proposed route from the coal regions to Conshohocken, in order to give the company access to Philadelphia. This road will go some distance west of Doyles town, because that is deemed most direct and best. Other lines have been run, as is usual in such surveys, but without any idea that they would be adopted. A route has also been surveyed from Philadelphia to New Hope and across the Delaware to Ringoes. This has been done merely to furnish the company with information, and as a completion to previous surveys and maps, and not with any idea of embarking in a new Philadelphia and New York line over that route."

Mr. TAIT also says that the actual route as surveyed will not be more than a mile or two longer than the Bound Brook route, and is the most direct, barring Bound Brook, to New York. An air line between Philadelphia and New York would strike between the two routes, but the necessary gradings and tunnelings would be insuperable objections. The line, as surveyed, crosses the Delaware above the Holcombe Riverview Cemetery, about a mile north of Lambertville, crosses the Flemington R. R. above the second covered bridge, and passes near Blackwell's Mills south of Ringoes. From Ringoes east to a junction with the Lehigh Valley R. R. the company already has a survey.

Pennsylvania.—At a recent meeting of the Chicago, St. Louis & Pittsburgh, and the Pittsburg, Cincinnati & St. Louis railway companies, a plan for the consolidation of the four Western lines controlled by the Pennsylvania R. R. was agreed to. This consolidation embraces the Chicago, St Louis & Pittsburg, the Pittsburg, Cincinnati & St. Louis, the Cincinnati & Richmond, and the Jeffersonville, Madison & Indianapolis railroads. The capital stock issue of the new company will be $75,000,000, and $75,000,000 in bonds will also be issued. These issues will take the place of the stock and bonds of the four present companies. It is estimated that only about $40,000,000 of the stock and $40,000,000 of the bonds will be required for present use; the remainder will be reserved for future improvements and betterments.

Morris County.—This company, operating a railway from Port Oram to Charlotteburg, N. J., 17 miles, has engineers in the field surveying extensions east to the proposed Peekskill bridge in New York and west to the Lehigh coal fields.

New York, Susquehanna & Western.—At a meeting of several men interested in the proposed railway from Stockholm to Byram's Cove, Lake Hopatcong, N. J., recently held, a company was organized and preliminary steps taken toward the construction of the road. The road will probably be operated by the above company when completed.

Delaware & New England.—At a meeting recently held the organization of this company was completed by the election of John W. Brock, of Philadelphia, President, and Arthur E. Newbold, of Philadelphia, Treasurer. The company was chartered by the Legislature of 1889 for the purpose of making available an all-rail through route from Delaware to New England by way of the Poughkeepsie Bridge over the Hudson and connecting railway lines which the corporators control.

New York, New Haven & Hartford.—Good progress is being made on the Shore Line improvements. The 24 miles of double track between Madison and Niantic will be completed and in use by July 1. At present there are 600 men engaged in the work. The grading has been completed for 20 miles, and 15 miles of the 24 of tracking have been completed and in use for some time. After July 1 the 13 miles between Niantic and New London will be begun. The work is expensive, as the line has been changed in several localities to eliminate curves. In some places it has been necessary to cut down through the rock 40 ft. The maximum grade is 30 ft., and the maximum curvature 2°. Between Madison and Niantic are 13 iron bridges with a total length of 525 ft. On the piece of four-tracking between Westport and East Saugatuck, on the New York division, 250 men are employed.

Maine Shore Line.—J. W. Green, the contractor for the construction of this road from Hancock to Calais, Me., is quoted as follows:

"I completed many weeks ago all my arrangements for the building of the Shore Line Ry. I have a contract with responsible parties in New York, signed and sealed, I agreeing to furnish money to build the road, and to do everything required by the Maine Central R. R. in the original proposition. The hitch comes right here—I am waiting the return of Hon. Frank Jones from Europe to have the Maine Central carry out its agreement through the committee, of which he is a member. Mr. Jones assured me on the day of his departure that there was nothing else to be done to complete the contract and build the road when the Maine Shore Line had complied with all requirements in the preliminary contracts with the Maine Central R. R. Co. The bondsmen are all ready to sign, in accordance with the stipulations in the contract, and the delay is not caused by any failure on my part."

Projects and Surveys.

Indiana Mineral Springs.—Chartered in Indiana to build a railway from Taswell, Ind., via French Lick, West Baden and Trinity to Indiana Springs where it connects with the Evansville & Richmond R. R. Among the incorporators are: D. J. Mackey, E. B. Morgan and Jas. L. Mackey, all of Evansville.

Valley.—This New York enterprise is being revived. The project is to build a railway from Kingston to Ellenville, N. Y., and surveys have already been made for the line. It is now announced that the road will be completed this season.

Newfoundland.—The contract for building the the 250 miles of government railway on the island of Newfoundland has been let to Middleton & Reid, of St. Johns, N. F. The contract price is $15,500 per mile.

Buffalo Dock & Connecting.—A company has been organized to build a belt line transfer railway at Buffalo, N. Y. The object of the road is to furnish connections and transfer facilities to the various roads entering the city. It is stated that all the surveys have been completed. Geo. A. Ricker is the engineer of the line.

Woonsocket & Pascoag.—A correspondent writes: Work is to be commenced on this old road at once. Engineers are now in the field making the location. A part of this line was graded nearly 37 years ago, and was originally embraced in the old Air Line scheme from New Haven, Conn., to Boston. Construction has been started on this section three times, and abandoned each time. There is now every reason to assume, however, that the road will be speedily constructed. E. G. Sweatt, of Woonsocket, R. I., is interested The contractor is Wm. H. Flynn, of South Berwick, Me.; B. F. Hancox, Sr., is Chief Engineer, and Geo. B. Hancox is Assistant Engineer.

Maynard Branch.—Negotiations are pending between the projectors of this Massachusetts railway and the officials of the Boston & Maine R. R., preparatory to the early commencement of construction. Henry A. Hancox is Chief Engineer.

Plymouth & Bourne.—At a town meeting recently held, the town of Plymouth, Mass., voted to subscribe $70,000 in aid of this road, which is projected to run from Plymouth to Bourne. The surveys have been completed, and the company formally organized. H. B. Taylor is largely interested. B. F. Hancox, Sr., is Chief Engineer

SOUTHERN.—Existing Roads.

Charleston, Cincinnati & Chicago.—One hundred and fifty tons of steel rails have arrived for the 25 mile section between Rutherfordton and Marion, N. C. Tracklaying will begin at once and be pushed as fast as possible. A. N. Molesworth, Chief Engineer, Johnson City, Tenn.

Chattanooga, Rome & Columbus.—It is probable that grading will not be commenced for some time on the extension from Carrollton to Columbus, Ga., for which the Rome Brick Co. has the Contract.

Savannah, Americus & Montgomery.—Good progress is being made on the extension from Lonvale to Montgomery, Ala. King & Hannon, who have the contract for the section between Lonvale and the Chattahoochee river, have a force of 160 men and a large number of teams at work. About 4 of the 14 miles between the two points have been graded, and it is expected to have the whole distance graded by June 30. From the Chattahoochee river to Montgomery the work will be comparatively easy, and it is thought that the whole line will be in operation by the end of the year.

Louisville & Nashville.—Preparations are being made for the early commencement of construction on the line from Clarksville to Dickson, Tenn. Headquarters have been established at Clarksville and work will begin soon. The line will be about 85 miles long.

Louisville, New Orleans & Texas.—About 8 miles of track have been laid on the Yazoo branch of this road.

East Tennessee Land Co.—J. P. Suverkrop, of Harriman, Tenn., Chief Engineer, writes as follows:

Messrs Fink & Ryan have the contract for building this four mile railway around Harriman, Tenn., and track-laying is now in progress, one mile being already completed. The work is generally light; maximum grade 1.5 per cent. and maximum curve 12 degrees. The road is being built in the interest of the East Tennessee Land Co., and will connect with the East Tennessee, Virginia & Georgia and the Cincinnati Southern railways. Gen. C. B. Fisk, of New York City, is President.

Roanoke & Salem Dummy.—J. H. Wingate, of Roanoke, Va., Chief Engineer, writes as follows:

The location has been completed and the contract let for this road, which is projected to run from Roanoke to Salem, Va., a distance of 7¼ miles. Geo. O. Houston & Co. have the contract, and work is now in progress. It is expected that tracklaying will begin about June 20, and that the road will be completed by Sept. 1. The maximum grade is 2%, and the maximum curve 20°. The road is being built in the interest of the Roanoke St. Ry., and the principal business will be the passenger traffic, although the road will do both a freight and passenger business. C. O. Leary is President, and J. F. Christian is General Manager.

Projects and Surveys.

Columbia, Geneva & Western.—Surveys are reported in progress for this Alabama railway which is projected to run from Columbia to Geneva, 50 miles,

Middle & East Tennessee.—The amount necessary to secure the right of way of this road from Gallatin to Hurtsville, Tenn., has been subscribed, and it is announced that work will be commenced in a few days.

Alabama, Georgia & Florida.—This company has been chartered in Alabama to build a railway from a point near Birmingham, Ala., to Jerigan, Ala., and Columbus, Ga. The line will be about 200 miles long. Among the incorporators are: G. G. Jergan, T. C. S. Harwood, Clifton Jours and M. C. Gray, all of Columbus, Ga.

Augusta & West Florida.—Wm. Bailey, of New York City, has been elected president of this road, and James N. Jackson, of Augusta, Ga., vice-president. It is stated that the entire line will soon be put under construction.

NORTHWEST.—Existing Roads.

Chicago, St. Paul, Minneapolis & Omaha.—Chas. W. Johnson, Chief Engineer, St. Paul, Minn., writes us that the contract for building the line from Neillsville to Marshville, Wis., 23¼ miles, has been let to Shepard, Siems & Co., of St. Paul, and that about 200 men are now at work upon the line. It is expected that tracklaying will begin about August, and the road completed by October. The route is through a hard wood timber region the entire distance.

Chicago, Milwaukee & St. Paul.—A. Harrison & Co. have sublet the contract for the Dexterville-Necedah branch to Allen McDougal, of Mankato, Minn., and to F. Lloyd & Co., of Depere, 10 miles each.

Projects and Surveys.

Chicago, Baraboo & Northern.—Chartered in Wisconsin to build a line of railway from Jeffersonville, Wis., via Baraboo, to Kilbourne City, a distance of 75 miles. Among the incorporators are: Frank Avery, H. P. Jones, D. E. Welch, J. B. Donovan and others.

Quincy, Keokuk & Chicago.—Incorporated in Illinois to build a line of railway from Quincy, Ill., to Niota, Ill., and to operate a railway from Keokuk, Ia., to Hamilton, Ill. Among the incorporators are: C. R. Arnold, of Warsaw, Ill., Jas. M. Bishop, of Quincy, Ill., and A. Cread, of Chicago.

Midland Pacific.—At a recent meeting the following officers were elected: President, Samuel L. Tate; Vice-President, Jas. Sampson, of Sioux City, Ia.; Secretary, Delos Bench, and Treasurer, C. G. Ferguson.

Manitoba & Southeastern.—Surveys are in progress from Winnipeg, Man., southeast to the Lake of the Woods. Alex. Logan is President.

Delavan, Lake Geneva & Chicago.—Chartered in Wisconsin to build a line of railway from Delavan to Duck Lake Junction, Walworth Co., a distance of ten miles. Among the incorporators are: W. H. Horton, A. M. Phillips, W. W. Bradley, and others.

SOUTHWEST.—Existing Roads.

Chicago, Rock Island & Pacific.—The Indian Territory extension of this road has been completed from Okarche to Minco, I. Ter., 29.5 miles, since Jan. 1, 1890. Construction is discontinued for the present.

The annual report of this company for the year ending March 31, 1890, gives the following results from operations:

Gross earnings	$17,639,060
Operating expenses and taxes	12,475,067
Net earnings	$ 5,163,993

Kansas City, Fort Scott & Memphis.—It is stated that the arrangements are completed for the construction of a line from Minden to Carthage, Mo. Two routes have already been surveyed, one on each side of the Spring River.

Projects and Surveys.

Corsicana & Southeastern.—The engineers of this road have completed the survey from Corsicana to the International & Great Northern Ry.

New Orleans Belt.—A press dispatch from New Orleans, La., says:

The Texas & Pacific, Illinois Central, Southern Pacific, Mississippi Valley, and New Orleans & Northeastern Rys. have formed the New Orleans Union Ry Co. for the purpose of building a belt road connecting the railways in the city and affording increased facilities to all commercial and industrial enterprises and river and marine shipping. The directors of the company are: ohn A. Grant, General Manager of the Texas & Pacific; John G. Mann, Superintendent of the Illinois Central; Julius Krutschnitt, General Manager of the Southern Pacific; J. T. Harahan, General Manager of the Mississippi Valley, and John Glenn, Jr., Resident General Agent of the New Orleans & Northeastern, and the Mayor of the city of New Orleans, ex-officio. The officers of the company are: Julius Krutschnitt, President; M. R. Spellman, Vice-President and General Manager, and John Glenn, Jr., Secretary and Treasurer.

Tennessee, Arkansas & Texas.—The temporary organization of this company has been made permanent and a board of directors elected. The road, which will be built by a construction company, will run from Little Rock, Ark., to Paris, Tex., via Hot Springs, Ark. The three cities have subscribed $240,000 in aid of the enterprise.

ROCKY MOUNTAIN AND PACIFIC.—Existing Roads.

Ogden & Hot Springs.—F. W. Lafrentz, of Ogden Utah, Secretary, writes us as follows:

This road, which is projected to run from Ogden, via North Ogden and Pleasantview to Hot Springs, a distance of 9 miles, is being built by the Ogden & Hot Springs Railway and Health Resort Co. The surveys have been completed and the contracts let. The principal business of the road will be the suburban freight and passenger traffic. The officers are: Watson B. Farr, President, and F. A. Calkins, Chief Engineer.

Union Pacific.—President Adams is reported as speaking as follows of his recent visit to the Northwest Pacific states:

"It was determined to extend our line from Portland to Tacoma and Seattle at once, if the step is approved by the board of directors. Beside this line we will build one or two little spurs to mining districts. All reports about other Union Pacific extensions in that country are mere talk. The company has no present intention of constructing a line into any part of California or of coming to San Francisco. All the resources at its command are required in fields more legitimately its own. Its relations with the Southern Pacific company were never more friendly than at present. The policy of the Union Pacific is entirely a conservative one. We realize, more perhaps than any

other line, that the Union Pacific and the Central Pacific roads were constructed at the same time, and the purpose for which they were constructed can best be accomplished by their acting in harmony. When the Union Pacific will build into this state depends entirely on the contingencies of the future and on the course which the Southern Pacific adopts towards the Union Pacific. If the Southern Pacific continues to deal with us in the spirit recently shown, the thing is a good ways off."

Regarding the progress and objects of the extension from Milford, Utah, to Pioche, in Southern Nevada, which is generally expected to reach into Southern California. Mr. Adams said:

"The construction of this line is going forward as rapidly as possible. We already had a line from Salt Lake City south to Milford and Frisco. The extension had insufficient business, and our investigations caused us to believe that an extension to the Pioche mining district would justify itself in connection with the existing road. The only important extensions which the Union Pacific is now engaged in are the line to Pioche, 140 miles, and the one to Puget Sound, 185 miles."

Northern Pacific.—A press dispatch says:

It is reported that the Northern Pacific has begun extending its Helena, Boulder Valley & Butte line. As reported, the extension begins at Colvin, the present terminus, and follows Boulder creek, giving it a northwestern direction which will bring the road within three miles of Champion. Although not known for a certainty, it is thought the line will ultimately be extended so as to bring it into Butte from the northwest.

Port Townsend Southern.—Work on this road is progressing rapidly. About 1,500 men are now at work on the line, and it is expected that it will be completed in time to transport ne xt year's wheat crop.

Projects and Surveys.

Contra Costa Co., Cal.—Several surveys have been made for lines of railway passing through this county. The lines run from Suisun Bay to Walnut Creek. It is thought that the Southern Pacific is at the back of the scheme.

Wyoming, Salt Lake & California.—It is stated that the property of this Utah company has been transferred to Eastern capitalists, and that the road will be immediately built from Salt Lake City west to the Grantsville and Clifton mining districts.

Northern Pacific & Idaho.—Chartered in Washington to build a line of railway from the Spokane & Palouse road, in Washington, to Nez Perces Co., Idaho, a distance of 91 miles.

RAPID TRANSIT.

Electric Railways.—The Chicopee, Mass., street railway will substitute Electricity for horse power

The Holyoke, Mass., Street Railway Co. has sold its franchises and property to a syndicate of capitalists representing the Springfield Street Railway Co. who propose making improvements and extensions. The plans comprehend an electric railway system about 15 miles long connecting the cities of Springfield, Chicopee and Holyoke and the village of South Hadley Falls. The movement has been brought about by the Springfield Board of Trade with the object of building up that city by furnishing it rapid transit with the surrounding towns. The plan eventually contemplates an extension of the electric system to Northampton, adding fully 15 miles more to the system. Indian Orchard, 5 miles east of Springfield, will be connected before the present year is over, and Palmer will come next, and the absorption of territory will not end until fully 50 miles of street railroad are under control of the Springfield Company.

The Troy Hill Electric Co., will build an electric street railway between Sharpsburg and Allegheny, Pa. The route of the line will be from Sharpsburg to Etna, to Millvale borough and thence across the ravine at Willow grove to Troy hill, then down the Troy hill road along Vinial street to North avenue. The tracks of the Pleasant Valley company will then be used to the Diamond square.

A company is being organized in Kittanning for the purpose of building an electric railway from that place to Ford City, Pa., a distance of about 7 miles. This enterprise is being taken hold of by all the capitalists in the town; and nearly all the stock has been subscribed, and when the required amount is forthcoming a charter will be taken out.

Braddock, Pa., Councils have been petitioned for right of way through that town for an electric street railway to extend from Pittsburg to Wilmerding.

The Lynn & Boston Street Ry. has petitioned for the privilege of using electricity on its lines at Lynn, Mass.

The Brooklyn (N. Y.) City R. R. Co. has petitioned for power to use electricity for motive power on its lines at Brooklyn, N. Y.

John S. Crump, who has the franchise for a 4-mile street railway at Columbus, Ind., has let the contract for constructing the road to Scott & Lyle, of Louisville, Ky. Work will be commenced at once. The motive power will be horses for the present, but it is the intention to use electricity ultimately.

The Belt Line Street Ry., of Savannah, Ga., has been sold to a syndicate of Nashville, Tenn., capitalists who have reorganized the company, and will substitute electricity for animal power. The overhead system will be used, and a committee has been appointed to contract for the plant. The road will be in operation by Aug. 15.

The citizens of Rockford, Ill., have subscribed $50,000 to secure a 5-mile extension of the electric railway.

A syndicate of eastern capitalists has perfected arrangements to purchase the street car lines of Salina, Kan., and transform them into electric motor and rapid transit lines.

The Cornwall, Wash., Street Railway Company has decided to use an electric motor on its street car lines in Whatcom, and horse power on its outside routes. The rails and fixtures are now on their way from New York. Two other companies are also seeking street car franchises —electric and cable—from the Whatcom city council.

The Cross Town Electric Railway Company, of Denver, Colo., will build branches and extensions.

The electric railway to be built at Great Falls, Mont., will be extended to the Montana smelter and Giant springs. It is claimed it will be the longest electric railway in the State.

Horse Railways.—W. P. Lett, City Clerk, Ottawa, Ont., advertises for tenders for the privilege of building and operating lines of street railway in that city.

The Naumkeag Street Railway, of Salem, Mass., has been sold to a syndicate of New York capitalists. The price paid was $125 per share, amounting to $312,500. This system of street railways covers lines from Salem to Peabody, Danvers Asylum, Beverly, Wenham, Asbury Grove, Beverly Cove and Fort Sewall, Marblehead. It is said to be one of the most prosperous systems of street railway in New England, the stock having paid 8 per cent. for years. The officers of the new company are Benjamin Orne, of New York, president; Joseph F. Hickey, of Salem, treasurer and general manager, and John Brickford, electrical engineer. There are 31 miles of track to be equipped with the Sprague overhead electric system.

The contract for grading and laying the track for the Huntington, N. Y., horse railroad has been given to a firm from North Carolina. The work will begin at once.

The Union County R. R. Co., a branch of the Philadelphia Syndicate, has obtained a franchise from the City Council of Elizabeth, N. J., to build 4¼ miles of street railroads through the northern and western parts of the city, including also a branch road along Third St., which is the main highway connecting the eastern and western portions of Elizabethport.

The Allegheny & Bellevue St. Ry. Co. has been granted right of way through the village of Bellevue, Pa.

The street car system of Louisville, Ky., embracing about 150 miles of track, now owned by two companies, has been sold to a syndicate of New York and Philadelphia bankers for figures estimated at $5,000,000.

The Austin (Tex.) Rapid Transit Co. is desirous of letting contracts for the construction of five miles of street railways.

Dummy Railways.—An ordinance has been introduced at the regular meeting of the Board of City Commissioners of Pensacola, Fla., granting to a company of Pensacola and Birmingham capitalists the right to construct through the streets of that city, a line of street railway to be operated by dummies. The proposed line will embrace nearly every portion of the city, and will be about 15 miles in length. The ordinance was referred to the street committee, who will report their action at the next meeting of the board.

The City Council, of Champaigne, Ill., has passed an ordinance permitting Frank L. Jaques, proprietor of the Champaign & Urbana street railway, to extend its line on the guaranty that the road be made an electric one inside of two years.

A number of McKeesport, Pa., capitalists and monied men from elsewhere are forming a company to construct a short line from McKeesport to the South Side, Pittsburg, by an overland route. The distance is only about 7 miles, and by use of an incline or two and a half dozen short tunnels the capitalists claim they can build the road and land passengers in Pittsburgh in about 15 minutes, less than half the time now required.

An electric street railway company has been organized at Atchison, Kan., with George Storch as President, W. W. Hetherington as Treasurer and G. H. Williams, of Des Moines, Ia., as secretary.

HIGHWAYS.

Illinois.—The $50,000 in bonds voted by Centerville Station Township to build rock roads in that township having been illegally issued, from technical irregularities in the election, are nil, and at the monthly meeting of the Highway Commissioners of that township recently, at New Brighton, it was decided to proceed to have another election on the question of issuing the bonds. Signers for the call will be obtained, and the election will be ordered as soon as possible, and an effort will be made to have the election conducted in due legal form. It is to be hoped that this great enterprise will not be prevented by the alleged irregularities, and that this great improvement of building the proposed rock road will be consummated.

WATER-WORKS.

NEW ENGLAND.

Burlington, Vt.—The Board of Water Commissioners has applied to the Board of Aldermen for $13,000 to be used in increasing the capacity of the old reservoir to 3,000,000 galls.

Attleboro, Mass.—A new stand-pipe is to be erected on Capron Hill.

Jamestown, R. I.—The construction of the new works has been commenced. The stand-pipe, to be erected on the high ground near Howland Ave., will be 30 ft. in diameter by 60 ft. high.

Riverside, R. I.—A water-supply system for damestic use and fire protection is to be established by the Riverside Water Co. Jerome Potter, Charles Bradley, Arthur B. Emmons and others are interested. The supply will be taken from a spring.

MIDDLE.

Elizabethtown, N. Y.—A larger main is to be laid by the water company to connect the spring with the reservoir.

Rochester, N. Y.—Sealed proposals will be received by the Executive Board until June 20, for furnishing cast-iron water pipe and specials for the city mains, as follows:

40 net tons of 12-in. straight pipe; 108 net tons of 10-in. straight pipe; 56 net tons of 8-in. straight pipe; 215 net tons of 6 in. straight pipe; 32 net tons of 4-in. straight pipe; 25,000 lbs. of special castings, for connecting with cast-iron water pipe, 12, 10, 8, 6, and 4 ins. internal diameter. The special castings will comprise three and four-way branches, reducers, curves, and sleeves, and they will be classed by their largest diameters. Address Thomas J. Neville, Clerk.

On June 1, George W. Rafter, Asst. Eng. Rochester Water-Works, reported on the quality of the artesian well water of Gates, N. Y. This well was drilled 25 years ago for the purpose of testing the existence of oil or gas. A large flow of water was struck and the well was plugged and abandoned. The depth of the well is unknown, common rumor varying between 60 ft. and 1,600 ft.; the weight of evidence points to about 150 ft. as the probable depth. This well was tested by Mr. Rafter and the daily flow over a weir was 300,000 galls. in 24 hours, and the average for 7 days by pumping was about 930,000 galls. in the same time. Mr. Rafter concludes that with proper piping, and probably another well, a safe daily yield of 1,000,000 galls. can be depended upon. From a sanitary point of view the water is above reproach. It is harder than Hemlock Lake water, but it is absolutely free from organic impurities. Chief Engineer Tubbs, of Rochester, concurs in the report and thinks it is possible to utilize this artesian water in this season of scarcity of other supply. He estimates the cost of machinery and connections at $12,000.

New Utrecht, N. Y.—James A. Townsend and Adolphus Bennett, of Bay Ridge, and Charles H. Lottman, of New Utrecht, are the trustees of the Ardmore Water Co., incorporated on June 7. Its objects are to accommodate, store, conduit, sell, furnish and supply water for mining, domestic, manufacturing, municipal and agricultural purposes. The capital stock is $2,500.

Syracuse, N. Y.—Judge Churchill has granted a temporary injunction, preventing the sale and issuance of the $500,000 of improvement bonds for water purposes.

Cohoes, N. Y.—A petition has been received from the Water Board asking the Common Council to issue $25,000 of bonds for laying new mains on Central, Park, and Bridge avenues, under the authority granted by the bill which recently passed the Legislature.

Ellicotteille, N. Y.—Surveys for the proposed works have been completed.

Chatham, N. Y.—Mains are being laid to supply the county house at Ghent with water.

Schnectady, N. Y.—J. N. Ward, of Jersey City, contractor for laying the new main to take the water supply from the river, has begun work.

Camden, N. J.—Parties are before the Legislature, asking for the repeal of the act allowing the Common Council to bond the city for $1,000,000 for an increased water supply. The objectors urge that it is inexpedient to trust the authorities with this sum, as they have not agreed upon any practical plan of supply. They admit that the present supply is inadequate, but claim that a $2,000 driven well would supply 1,000,000 galls. of good, wholesome water per day, and an expenditure of $30,000 will give them all the water wanted.

Orange, N. J.—The Board of Health reports that the water supply is to some extent contaminated, and that its long continued use without boiling might lead to impairment of health. The Board has instructed the Common Council to clean up the reservoir, and remove stumps and roots, and all brush adjoining it.

Highlands, N. J.—The Citizens' Water-Works Co. has been incorporated by J. Pierpont Morgan, James Parker, George T. Balch and Charles Edward Tracy, of New York; Caleb Huse and Harriet Pinckney Huse, of Highlands, and Rignald Marvin Huse, of South Bethelehem, Pa. The capital is $25,000.

Hughesville and Picture Rocks, Pa.—Bids are wanted by J. K. Reshel, President Hughesville Water Co., for building a gravity system of works consisting of a masonry dam, about 4¼ miles of cast-iron main pipe with intersections to supply the towns of Hughesville and Picture Rocks, fire-plugs, etc., for public use. Plans and specifications will be furnished upon application.

SOUTHERN.

Richmond, Va.—The Board of Aldermen has passed resolutions authorizing the Committee on Water to place water meters in private residences occupied by two families.

Salem, Va.—It is reported that the Salem Development

Co. will build works, taking water from a spring 9½ miles distant.

Laurens, S. C.—We have received the following:

No arrangements have as yet been made for establishing works.

Charleston, S. C.—Surveys for a conduit line to convey water from a spring near the Springfield plantation have been completed by City Engineer Winn.

Meldrum, Ga.—A daily flow of about 86,000 galls. per day is being secured from an artesian well at a depth of 335 ft.

Albany, Ga.—Water will be pumped from an artesian well to stand-pipe 100 ft. high. The estimated cost of the works is $20,000. Nelson Tift is the contractor.

Griffin, Ga.—The citizens have voted to issue bonds for putting in works.

Eustis, Fla.—Correspondence with capitalists who will build works is solicited by A. D. Wright and Col. Hazzard. A company has been organized.

Richmond, Ky.—The Richmond Light and Water Co., has purchased land upon which to construct a reservoir.

Louisville, Ky.—Plans and specifications for the proposed improvements to the water-works are now being prepared. If approved of by the board of directors when completed, a vote upon the question of issuing $500,000 of bonds for carrying them out will be taken. As now proposed they include the laying of a 48-in. main from the Crescent Hill reservoir to the western part of the city, and the erection of a new stand-pipe to replace the one destroyed by the tornado in April.

NORTH CENTRAL.

Cleveland, O.—The Water-Works Trustees have voted to extend the tunnel into the lake two miles further. The estimated cost of the extension is $662,000.

Columbus, O.—Petitions for laying mains on College street and several avenues have been presented to the City Council.

Indianapolis, Ind.—The company proposes to lay a considerable amount of 24-in. pipe this season.

Imlay City, Mich.—A flowing well has been struck at a depth of 140 or 160 ft.

Centralia, Ill.—The City Council has voted down a resolution to submit the question of establishing a system of works to a vote of the people.

Chicago, Ill.—The question of extending the system to afford a more adequate supply to Hyde Park, Lake and Lake View is being discussed. For benefiting Hyde Park and Lake it is proposed to lay a 36-in. main from the Hyde Park pumping station along Sixty-seventh street at an estimated cost of $200,000, or to extend the present tunnel one or two miles further into the lake. For improving the Lake View supply it has been decided to extend the tunnel one mile further into the lake at an estimate cost of $100,000.

Waupaca, Wis.—The Common Council is considering the question of putting in works this season. "The natural advantages offered here for a successful system are greater than in most cities, there being a large hill in the western part of the city, admirably adapted for a reservoir, while at the foot of the hill is a fine water-power in the Waupaca River."

Lake Geneva, Wis.—The Lake Geneva Water & Light Co. has been incorporated with a capital stock of $40,000. The incorporators are: James E. Heg, Edward P. Wheeler and James C Reynolds.

Milwaukee, Wis.—Sealed proposals will be received until June 20 for furnishing all materials and doing all the work necessary and required to construct a water-works tunnel, 7½ ft. in diameter, 3,000 ft. long, under Lake Michigan, including two shafts, wells and crib, according to specifications on file. Address George H. Benzenberg, City Engineer.

Oconto, Wis.—Bids will be received on June 15 for constructing a system of works. H. J. Hilbert, of Milwaukee, Wis., is the engineer in charge. Address Charles Norton, City Clerk.

NORTHWESTERN.

Webster City, Ia.—Extensions are being made.

Sioux City, Ia.—The following is taken from the Sioux City *Journal:*

The City Council has commenced advertising in Eastern engineering papers for bids on the contract for putting in the extensions of the water mains ordered in a resolution adopted a short time since. Bids will be opened and the contract awarded early in July. The cost of the work is estimated at $25,000.

Sioux Rapids, Ia.—The city has let a contract for building a small system of works. The contract price is $5,995.

Phillipsburg, Kan.—The citizens have voted to issue $30,000 of bonds for new works.

Pittsburg, Kan.—N. W. Harris & Co., of Chicago, Ill., have purchased the existing works and increased the capital stock to $250,000 and issued $250,000 of bonds. New machinery and buildings will be erected and the mains will be enlarged and extended.

Vermillion, So. Dak.—A liberal franchise will be given to any party, or corporation, that will put in a system of water-works. Population, 2,000. Artesian water can be obtained in the city to any amount. Address F. N. Burdick, Mayor.

Fargo, No. Dak.—Sealed proposals will be received until July 7 for constructing a pumping station and putting in a complete new water system, including power, mains, hydrants and settling basin, and all things necessary to supply the city with water and fire protection, in accordance with the plans and specifications now on file. Materials will be required approximately as follows:

1,270 ft. of 12-in. pipe; 1,125 ft. of 10-in. pipe; 8,825 ft. of 8-in. pipe; 33,770 ft. of 6-in. pipe; 5,894 ft. of 4-in. pipe; 71 hydrants, and 41 service and valve boxes. Also for extending the water system now in operation so as to cover the circuit indicated in the plans and specifications, requiring about 1,625 ft. of 8-in. pipe; 15,400 ft. of 6-in. pipe; 2,362 ft. of 4-in. pipe, together with hydrants and service and valve boxes.

A certified check made payable to the City Treasurer for $2,000 is required. Address A. O. Rupert, City Auditor.

Fort Russel, Wyo.—A new system of works is being put in. Underground canals are being built at a cost of $20,000 to supply the garrison with filtered water.

Livingston, Mont.—The new works have been satisfactorily tested and accepted by the city. They were put in by E. Sutphin.

Chinook, Mont.—The Chinook Artesian Water Co. has been incorporated by J. W. Stam, E. H. Combs, J. Many, A. H. Reser and L. V. Bogy. Capital stock, $2,000.

Hot Springs, So. Dak.—C. E. Sawyer informs us that nothing has been decided upon. The proposed plan is to build a reservoir, and take the supply from a spring or creek.

SOUTHWESTERN.

Goldthwaite, Tex.—The artesian well has reached a depth 563 ft. and water stands within 20 ft. of the top. The well will be sunk to a depth of 3,000 ft. if necessary to secure flowing water. It is 10 ins. in diameter at the top and 7 ins. at the bottom.

Galveston, Tex.—It is proposed to sink an artesian well as a means to increase the supply.

Lake City, Col.—The new works have been completed.

Boulder, Col.—The City Council has opened bids for constructing the new works, exclusive of the mountain system and the new reservoir. The contract was awarded to Igo & Howard, of Greeley, Col., at $8,675.95. The cost of the town system is $40,000, including the new reservoir, and the mountain system, $65,000.

Pueblo, Col.—The Board of Aldermen has extended the franchise of the South Pueblo Water Co. for a period of 25 years, or to 1915. By the ordinance the company is given exclusive rights to supply water to all that portion of the city south of the Arkansas River.

PACIFIC.

Colfax, Wash.—A copious flow of water is being secured from the artesian well at a depth of 200 ft.

Centralia, Wash.—The following is taken from the Centralia *News:*

The people are not in favor of bonding the city for the purpose of erecting water-works, believing that the work can be better and more expeditiously done by private parties.

Tillamook, Ore.—The following is from Claude Thayer:

The contracts for building the works will not be let until next Spring. No estimate of the cost has yet been made. The proposed source of supply is a mountain stream, 6 miles distant. The Tillamook Water Co. has been formed. G. O. Nolan can furnish information.

Portland, Ore.—The city has sold $50,000 worth of bonds to Ladd & Tilton, at $55,280.

Dixon, Cal.—The new works have been completed and put into operation.

Los Angeles, Cal.—An effort is being made to consolidate the water companies.——Councilmen Ellsworth, Moss and Innes have been appointed a committee to investigate and report upon the question of the city issuing bonds, constructing and maintaining its own works.

Lodi, Cal.—The new works have been put in operation.

Boise City, Idaho.—A new corporation was formed on May 31 to supply the city with water. Springs have been found at the base of the Boise range yielding an abundant flow of water.

Pocatello, Idaho.—The Idaho Artesian Well Co. wil at once begin sinking a 500-ft. artesian well.

Battle Mountain, Nev.—We have received the following from E. Carroll:

The construction of the new works is now in progress They are to be completed by Sept. 1. Water will be conveyed by gravity direct to mains. The estimated cost is $4,000. Engineer, S. L. Cohoon. The contractors are Cohoon & Blossom.

Salt Lake City, Utah.—S. H. Bacon, President of the Bank of Salt Lake, has addressed the City Council upon the subject of purchasing the existing works, and made application for a franchise if the city should decide to grant one.—The Water Commission has submitted its report upon the question of improving the supply. They recommend that a large main be laid, or a masonry conduit be constructed, at once, to bring to the city by gravity the water from Emigration and Parley creeks, from which it is estimated that a daily supply of 8,000,000 galls. can be obtained. The estimates of cost are as follows:

Riveted steel pipe (California system)	$166,454
Masonry conduit, Parley's Creek to city, and pipes from Emigration Creek	150,487
Riveted pipe for a 13,000,000 galls. supply	206,996
Brick conduit, Parley's to city, pipes from Emigration	183,140
Pipes, etc., for entire available supply	201,198
Pumping machinery, etc	142,120

CANADA.

Montreal, P. Q.—Superintendent B. D. McConnell will receive sealed tenders until June 24, for 2,300 tons of cast-iron water pipe, to be supplied to the City of Montreal in quantities and at dates stated in the specifications.

Toronto, Ont.—The annual appropriation for water-works is $1,396,000.

FOREIGN.

Japan.—Japan is well provided with water by nature but indifferently by art, and hence most of the large towns are bestirring themselves to get the European system of water-works. Nagasaki and Tokio, for instance, are arranging for a supply of three to four cu. ft. per head of the population in twenty-four hours. As Tokio contains about 1,500,000 inhabitants, the new water-works will be among the largest in the world. When the sanitation of Japan is improved by Western engineers it will be one of the healthiest countries in the world. Even now it is called the "Sanatorium of the East."—*London Globe.*

PROJECTS.

Griffin, Ga.; McDonough, Ga.—Lakeside, Fla.; James Bristow & Son, Green Cove Springs, Fla.; Lorenzo Taylor, Apalachicola, Fla.—Spring City, Tenn.—Anglo-American Association, Shambaugh, Mich.—Elroy, Wis.—Merna Neb.

ARTESIAN WELLS.

Glendive, Mont.—The artesian well is down 335 ft. At 120 ft. water was struck that rose to within 20 ft. of the surface. A strong flow is expected at a depth of between 400 and 500 ft.

Springfield, So. Dak.—Bonds will be voted for putting down a well.

Tucson, Arizona.—The Board of Regents of the Arizona University has resolved to sink an artesian well 1,500 ft. deep to test the water question in this section of Arizona. Proposals are wanted.

IRRIGATION.

North Yakima, Wash.—W. Hamilton Hall, State Engineer, of California, has approved the McIntyre survey of a large irrigation canal, and work will start at once.

SEWERAGE AND MUNICIPAL.

Sewerage.—Kansas City, Mo.—An ordinance has been passed to build a sewer in district No. 35.

Roanoke, Va.—The Glade Land Co. will construct a system of sewers in the Glade addition. Roanoke itself is discussing the expenditure of $50,000 for sewerage.

Talladega, Ala.—M. G. Brannon, of Louisville, Ky., has contracted to build seven miles of pipe sewers, from 6 to 8 ins. diameter, for $25,425.

Troy, N. Y.—The Sewer Committee has favorably reported resolutions to build a considerable number of oval brick sewers, from 30 × 45 to 37½ × 56 ins.

Sanford, Fla.—The Finance Committee strongly recommend the bonding of the city for $40,000 for new sewers, and $10,000 for new school buildings. The action proposed has the support of the majority of the citizens.

Buffalo, N. Y., announces under date of June 3 eight sewers to be built, ranging from a 5-ft. 3-in. brick sewer to 10 to 24-in. tile sewers. The engineer is directed to prepare plans and specifications and to advertise for proposals.

Taunton, Mass., demands a new system of sewerage. Mayor Alger and the citizens generally are loud in their condemnation of the present system, and at least a new trunk sewer is demanded at once.

Tyler, Tex., has closed a contract for building a complete sewerage system, with 7¼ miles of mains to be laid at once.

Butte, Mont., contemplates spending about $37,500 on 13,500 ft. of pipe sewers. Including repairs, etc., the total expenditure will be about $44,800.

Pittsburg, Pa., is soon to advertise for the building of sewers on Grazier and other streets and on Aiken Ave A large number of pipe sewers are also to be built.

Springfield, Mo., has voted to spend $150,000 in constructing a separate sewerage system under the plans of Col. Geo. E. Waring, Jr., with about 19 miles of mains.

Watseka, Ill., is to build a large sewer within the next three months, under the charge of Jacob A. Harman, the Surveyor of Iroquois County.

Los Angeles, Cal., through Mayor Hazard, complains that the decision of that city to build more pipe sewers has encouraged the formation of a pipe ring that has advanced the price of the pipe wanted from $24,000 to $30,000.

Mount Vernon, O., is considering the construction of a complete sewerage system.

La Salle, Ill.—The City Council has voted $15,000 to be expended on sewers this summer. Mr. Wm. P. Rounds, engineer in charge.

Sewers.—Atlanta, Ga., has authorized the construction of several new sewers.

McKeesport, Pa., has awarded contracts for sewerage, amounting to about $85,000, to Kelling, Ridge & Co., and Sloan and McIlvain, both of Pittsburg.

Gloversville, N. Y., has ordered a lot of tile sewers to be put down.

Chicago, Ill., is to build a main sewer from the South

Branch of the Chicago River to Twenty-second St., to cost $72,000; a $28,000 sewer on Belmont Ave., and an extension of the North Ave. sewer, to cost $21,500.

Buffalo, N. Y.—The Board of Assessors announce assessments as follows: $69,900 for a 5 ft. 3 in. and 6 ft. 3 in. brick sewer on Albany St.; $135,900 for brick sewers from 3 to 7½ ft. diameter in Ferry St.; $13,450 for a 42 to 56 in. brick sewer on Niagara St., together with a number of smaller tile sewers.

Greenville, Tex., has let the construction of its sewerage system to Kellogg, Thomson & Co., of Denison.

Buildings.—Dubuque, Ia., is to issue $125,000 4 % bonds to build a new court house.

Shelby Co., Ia., wants to build a $50,000 court house.

Newport, R. I., is to submit to vote of taxpayers a proposition to purchase a site for a new city hall, at a cost of $200,000.

Lamars, Ia., is to build a $12,000 jail.

Greenville, Miss., has voted to build a new court house and jail. Contracts will be let on the first Monday in July.

Los Angeles, Cal., is to vote on the issue of $300,000 court house bonds, to complete the building already commenced.

Catonsville, Md.—A model casino building is to be put up by Messrs. Allen McLane and Henry Wilson, with tennis courts, bowling alley, etc.

Manitou, Col., is to build an "Auditorium" to hold 1,000 to 2,000 people, and to cost $50,000. The Manitou Auditorium Co. is already formed, with Major John M. Hulbert as a moving spirit.

Aurora, Ill., is to have a $75,000 government building, for which President Harrison has signed the bill.

Charlotte, N. C.—Trinity College is to be built at Durham, with Mr. S. L. Leary, of Charlotte, as architect.

Street Work.—Roanoke, Va., is discussing the appropriation of $100,000 for street improvement. The taxable property of the city is rated at $6,000,000 to $8,000,000, and the population is claimed to be 20,500.

Philadelphia, Pa.—A movement is afoot to repave Broad St. with asphalt. There is considerable opposition, however, on the part of those who think the present stone pavement is good enough, and that other parts of the city need improving more than Broad St.

Charlotte, N. C., is to spend $75,000 in street improvements under Mr. B. S. Guion, C. E.

Asheville, N. C.—About two months ago Hon. Richmond Pearson bought out, for $26,000, the quarter lately held by the lowest class of negroes in that town. He tore down the houses and laid out the ground in broad, newly graded and macadamized streets and has already sold lots to the amount of $106,660. His profit will amount to at least $75,000 on the transaction, aside from ridding the town of a most undesirable class of tenants.

San Francisco, Cal.—The Park Commission wants $50,000 for improvements, and the Superintendent of Streets has filed estimates covering work for the next fiscal year amounting to $426,711. The heaviest single item is $139,711 for reconstructing cobble-paved streets with basalt, not including $50,000 for concrete foundation not yet decided upon.

McKeesport, Pa., is spending about $50,000 in repaving its streets.

Pittsburg, Pa., advertises a large amount of street work to be done.

Long Branch, N. J., has sanctioned the construction of a new ocean avenue, to replace the one partially washed away by last winter's storms.

Savannah, Ga., is to improve the Louisville road and Gwinnett St., and City Engineer W. J. Winn estimates the cost as follows: 20 ft. wide and 5,600 ft. long; to pave with granite blocks, $27,999; wooden curbing, $392; if oyster shells, $6,720. For Gwinnett St., 15 ft. wide, 4,500 ft. long; granite blocks and wooden curb, $17,190; with oyster shells, $4,050. These estimates are yet to be acted upon.

St. Louis, Mo.—The Board of Public Improvement is considering the reconstruction of 34 streets and avenues in that city.

Martin's Ferry, O., advertises until July 3 for proposals for fire-brick pavement to the amount of 12,504 sq. yds. The contractor is to furnish and lay the material and give $200 bonds. R. F. Allender, City Clerk.

Rochester, N. Y., has adopted ordinances for asphalt pavement on Emerson St., $15,000, and Rowe St., $54,000; brick pavement on South Goodman St., $9,000. Smaller amounts of work were sanctioned at the same meeting on other streets.

Kansas City, Mo.—The City Council is considering ordinances to pave and curb Northrup Avenue, between 9th and 10th Sts. The contract to pave with asphalt Fifth St., from Minnesota to Armstrong Avenues, was awarded to the Barber Asphalt Co. at $2.80 per sq yd.

Buffalo, N. Y.—The Board of Assessors announce assessments as follows: $164,008, for paving Clinton St. with Trinidad asphalt pavement; Guilford St., $28,190; Berlin St., $12,940; Laudon St., $27,435; Oak St., $35,191; Wilson St., $8,017; Cooper St., $7,611; Laurel St., $11,883; Hamburg St., $28,833; Livingston St., $7,494, and E. Summer St. $14,719, all with A. L. Barber's genuine Trinidad asphalt pavement. A number of other streets are to be paved with second-class Medina sandstone, and many crosswalks are to be laid.

Chicago, Ill.—The Cicero Town Board has voted $60,000 for street improvements.

Greenbrush, N. Y., has advertised for proposals to pave Broadway with granite blocks, at a cost of about $75,000.

Columbus, O., authorises the paving of various streets with Hayden, Hallwood or other types of fire-brick pavement and 5-in. curb.

City Bonds.—Chicago, Ill., is selling $934,000 3½% city of Chicago bonds, dated July 1, 1890, 20 years' time.

Lincoln, Neb., will sell, on June 16, $85,000 6% paving bonds, payable in New York, and maturing in 1890, '92 and '93. D. C. Van Duyn, City Clerk.

ELECTRICAL.

Electric Lighting.—The Keeseville, N.Y., village trustees have signed an agreement with the Thomson-Houston Electric Company to put in a plant for lighting the village.

The contract for lighting the village of Medina, N. Y. by electricity has been signed. It was awarded to the Syracuse Electric Supply Co., which company handles the Thomson-Houston system. Work has already been commenced.

A committee has been appointed at Kittaning, Pa., to investigate and decide upon the best electric light system for that place.

The American Coal Co. will put in an electric light plant at the mines. J. H. Parrott, Lonaconing, Md.

Trinity Colleges, Durham, N. C., will put in an electric light plant.

The Spartan Mills of Spartansburg, S. C., will put in a Thomson-Houston electric light plant.

The Athens Electric Light Co., of Athens, Ga., will enlarge its plant.

Apalachicola, Fla., is considering establishing an electric lighting system.

Lawrenceburg, Tenn., is talking of an electric light plant.

Citizens' Electric Light and Power Co. has been organized at Cairo, Ill., to furnish electric light and power for railway and other purposes; incorporators, Henry Wells, Harris Schultze and Thomas Lewis.

It is stated that G. H. Van Etten, representing a Canadian syndicate, has purchased the plant of the Edison Electric Light Co., at Little Rock, Ark., for $65,000, and will make extensive improvements.

Franchises have been granted by the Council of Jamestown, R. I., for an electric light plant.

An electric light plant is being talked of at Versailles, Ky. The Thomson-Houston Co. has made an offer to furnish the city with 50 incandescent lights for $1,000 per year

An ordinance has been introduced granting a company a 10 years' franchise for lighting the city of Quitman, Ga., with electricity at $1,800 per year.

Electric Makrophone.—The Orient Electric Co., with a capital of $100,000, has been organized under the Maine, State laws to manufacture and sell the Blake Makrophone, or long distance sound transmitter, and all electrical appliances connected therewith. Its headquarters are at Portland, and its officers are: President, Robie Blake, Cornish; Directors, Robie Blake, of Cornish; Col. Edward Moore, of Deering; J. J. Gerrish, of Portland; Treasurer, H. R. Virgin, of Portland; Clerk, D. W. Scribner, of Portland; Counsel, Gen. Charles P. Mattocks, of Portland.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Shelburne Falls, Mass.*—A pamplet of 23 pages has been issued by the Shelburne Falls Bridge Committee, setting forth the specifications of the new proposed wrought iron, riveted lattice bridge, and the work to be performed by the contractor. It was prepared by Edward S. Shaw, the consulting engineer.

New York, N. Y.—The commissioners appointed to select the site for the proposed bridge across the Hudson River, have completed their organization, and are now ready to commence active work.

Redlock, O.—The Commissioners of Cuyahoga and Summit counties recently met in Cleveland and let contracts for the building of a bridge over the Cuyahoga River at Redlock. The stonework will be done by Fauble & Fauble, for $2,464, and the superstructure by the Variety Iron Works for $2,802.

Columbus, O.—The City Engineer has been ordered to prepare plans for a viaduct across the railway tracks on North High St.

Grantsville, W. Va.—The County Commissioners of Calhoun Co., have advertised for bids for the construction of a 225-ft. steel bridge over the Little Kanawha River.

Raleigh, W. Va.—A steel toll bridge is to be erected at this place.

Watertown, So. Dak.—The city council has let the contract for building the Boughton bridge to the Milwaukee Bridge and Iron works for $4,577, and the contract for remodeling and widening Main street bridge was let to the E. Kunert Manufacturing Co., of Watertown at $1,500, with an addition of $1 per foot for handrailing.

Canals.—The Lake Borgne Canal, connecting the Mississippi River with Lake Borgne, 6¾ miles long, has been completed and opened for traffic. The canal varies in depth from 7 ft. to 20 ft., and is intended to furnish passage for craft doing business on Lake Borgne to the river.

The Maryland & Delaware Ship Canal is reported to have passed into the hands of French capitalists who, it is stated, will complete the project at an early date. The canal is to connect the Chesapeake and Delaware bays. W. J. Roe, of 35 Broadway, N. Y., is the representative of the syndicate.

About 60 miles of the Great Colt Canal, in Colorado, have been completed, and the water turned in. Work is in progress on the remainder.

CONTRACTING.

Sewers.—Knoxville, Tenn.—Mr. R. F. Hartford, C. E., of Chattanooga, will prepare plans for a new sewerage system.

Boston, Mass.—Henry C. Eyre, of Chester, Pa., was awarded the contract for building sections A and B in the extension of the metropolitan sewerage in Boston and Brookline.

Baltimore, Md.—Proposals for material for the Carey street relief sewer were opened June 8 at the City Hall. The bids were as follows: McClenahan Bros., paving blocks, per 1,000, $119; per sq. yd., $2.05. Lumber, North Carolina pine, per 1,000 ft., Swain & Banks, $14.40, Virginia pine $13.40; P. M. Womble, $13 and $12. Round timber, chestnut, P. M. Womble, 16 ft. at 60 cts., and 18 ft. at 65 cts. Stone, per cu. yd., John Curley, $2 20; Schwind & Leonard, $1.47¾; John Harris, $2.80. Portland cement, per barrel, S. M. Hamilton & Co., for Crown Portland cement $3, for Burnham $2.75, for Cumberland $1.35, Cumberland in bags $1.12; C. M. McColgan & Co., for S. Anchor $2.78, for Ulster Co. $1.20, for Crescent Rosedale, $1.19; John Bullock & Sons, for R. T. $1.12, for G. Portland $2.80. Bricks, hand-made, per 1,000, Fred. Rice, $8.85; Pitcher & Creager, hand-made $8.95, machine-made $8.10; Young O. Wilson & Co., $9 and $8.50; James R. Busey & Son, $8.75 and $7.90; Carroll Buck Co., hand-made, $8.90. Sand, per cu. yd., Morgan & Bresman, 90 cts.; John Smith, 69 cts. The awards were not made.

Chicopee, Falls, Mass.—Sewer contracts awarded to C. B. Cadwell, of New Britain, Conn., at 90 cts. per lin. ft., and $48 for manholes. The sewer is 2,765 ft. long, of 20 in. vitrified pipe, 9½ ft. below street surface.

Minneapolis, Minn.—E. P. Allis & Co., of Milwaukee, has the contract for overhauling and refurnishing the Crown roller mill, from top to bottom, at a heavy expenditure.

Buffalo, N. Y.—City Engineer Mann has opened bids for paving the square bound by Elk, Michigan, Fulton and West Market Sts., at prices ranging from $13,390 to $14,450; and paving Main St., 40 ft. wide, with asphalt, the Barber Asphalt Company's bid was $40,650.

Street Work.—Sioux City, Iowa, has received bids for 169,635 sq. yds. of paving, as follows: With jasperite, $2.25 per yard; cedar block, $1.22 to $1.42; brick paving, $1.53 to $1.68; granite block, $2.20. Curbing bids were 60 cts. to 69 cts. per lin. ft. for Berea sandstone; 93 cts. for granite; corners, $2.75 to $4; St. Cloud granite, 92 cts.; Kansas stone, 72 to 75 cts.; Portland cement, 34 cts. All bids were referred to the Paving Committee.

Cicero Town, Chicago, Ill., has let street contracts amounting to over $43,000, and in Austin to over $57,000.

Little Rock, Ark., has let to the Little Rock Granite Co. the contract for grading and paving W. Third St. for $7,114.59.

Des Moines, Ia., has let the contract for grading the Capitol grounds to M. H. King, at 22 cts per cu. yd. Total amount about $25,000.

West Toronto, Can.—The Board of Works recommends that for the Kelee St. subway the excavation and masonry be let to B. Gibson, for $54,772, and the superstructure to the Dominion Bridge Co. for $10,250. These were the lowest bids.

Duluth has awarded the contract for paving Piedmont Ave. to E. J. Amory for $18,380; and for the sewer on Second Alley, to Zimmerman & Moore, for $6,159.95.

PROPOSALS OPEN.

Sewers.—W. A. Wadsworth, President Board of Sewer Commissioners, Genesee, N. Y. June 20.

Building.—To be of brick and stone-pressed brick outside. Dimensions, 75 ft. by 45 ft., and four stories high. W. D. Williams, Macon, Ga. June 30.

Sewers.—Thomas F. Gilroy, Commissioner of Public Works, New York City. June 19.

Street Work.—Grading, draining, curbing, paving with fire-clay paving brick and improving streets. O. G. Force, City Civil Engineer. June 26.

School House.—J. T. Wells, Clerk, Plain City, O. July 3

Railway Work.—Grading, masonry, tracklaying, trestling, etc., on the first division of the South Bound R. R. B. A. Denmark, President, Savannah, Ga.

Buildings.—For the G. A. R. headquarters at Sabetha, Kan. Ira F. Collins, Chairman, Ellsworth, Kan. June 25.

Paving.—Approximate quantity, 12,504 sq. yds. R. F. Allender, City Clerk, Martin's Ferry, O. July 3.

Pumping Engine.—An improved pumping engine of 10,000,000-galls. dy. capacity, giving a guaranteed duty of 110,000,000 ft. lbs., with boilers, etc., complete; the engine to be placed in the position now occupied by a 4,000,000-

gall. Worthington engine (which is to be removed and become the property of the contractor), as per plans and specifications to be obtained at the office of the superintendent. W. J. Hill, Chairman Committee on Water-Works, Toronto, Ont. June 30.

Court House.—In accordance with plans and specifications now on file, Adolph Meyer, President Police Jury, Calcasieu Parish, Lake Charles, La. July 7.

Artesian Well.—J. F. Stout, Mayor, Corsicana, Tex. June 20.

Dredging.—At Brooklyn (N. Y.) Navy Yard. N. H. Farquhar, Chief of Bureau of Yards and Docks, Washington, D. C. July 2.

Masonry Work.—For the Broadway bridge, over the River des Peres. George Burnet, President Board of Public Works, St. Louis, Mo. June 17, 12 M.

Sewers.—Constructing about 4,000 ft. of brick sewer. Road Commissioners, Everett, Mass. June 16.

Paving and Flagging.—John P. Adams, Commissioner, Brooklyn, N. Y. June 19.

Coaling Lighters.—H. J. Laslett, Naval Storekeeper, H. M. Dockyard, Bermuda. July 1.

Dock Work.—Commissioners of the Department of Docks, New York City. June 20.

Water Bonds.—F. A. Newell, Treasurer, Salem, Mass. June 18.

Boilers.—For furnishing materials and labor for the steam water tube boilers at the Ohio State University. Alexis Cope, Secretary, Columbus, O. June 24.

Roadway Construction.—Grading necessary for constructing 20,000.11 ft. 40-ft. roadway, and 5,800 11 ft. 60-ft. roadway. James G. Watkin, General Manager West Lynchburg Land Co., West Lynchburg, Va. June 16.

Pipe-Laying.—Wm. M. Dunlap, City Engineer, Roanoke, Va. July 7.

Sewers.—Building sewers, furnishing, laying material and erecting the main and trunk sewers, masonry, outfall, catch basins, etc. The quantities required are about as follows:

2,630 lin. ft., 30 in.; 9,420 lin. ft., 24 in.; 3,000 lin. ft., 20 in.; 420 lin. ft., 12 in.; 874 lin. ft., 8 in. pipe; 12 catch basins, 30 manholes, one flush tank, one crossing of river with 280 lin. ft. of 24 in. cast-iron pipe and T, and one length 12 in. cast-iron pipe.

A certified check for $500 is required. J. K. Smith, Clerk, Waukesha, Wis. June 17.

Court House.—In accordance with plans and specifications, which will be furnished upon application. P. E. Dunn, County Clerk, Crystal Falls, Mich. June 23.

MANUFACTURING AND TECHNICAL.

Steel Rails.—The Austin (Tex.) Rapid Transit Co. wishes to purchase 400 tons of 40 or 45 lb. steel T rails, f.o.b. cars, Austin, Tex.

The New York Equipment Co. has moved to the Wilkes Building, Wall and Broad streets. This company has opened a new departure, and is to lease locomotives, passenger and freight cars to railroads, logging railroads, mining contractors, etc., for long and short terms. They are now making shipments to Mexico and the South. The officers are: James Irvine, President; George B. Cooper, Vice-President, William B. Carolin, Secretary and Treasurer.

Road Roller.—An order has been passed by the Aldermen, of Cambridge, Mass., authorizing the purchase of a 15-ton steam roller

The Thomson-Houston Electric Co.'s exhibit at the American Water-Works Convention at Chicago was a creditable one. It was installed at the Grand Pacific Hotel, and consisted of about 200 lamps, running off of an alternating dynamo of their manufacture, located at the power house of the Chicago Arc-Light & Power Co. The lamps were tastefully arranged, showing a large star in the center of the ceiling, formed by about 100 colored lamps. At one end of the room were the letters "T.-H. E. C." about one foot in length. On the sides were arranged photographs of various electric roads now in operation, and also a number of stationary motor installations, showing methods to which the use of motors may be put.

Statistics of the growth of this company for seven years were posted on the walls. Arc-lighting from central stations had grown from 22 local companies, in 1883, with a capacity of 1,653 lights, to 516 companies in 1890 with 69,000 lights; the direct incandescent system, which was used by 29 companies in 1887 with 11,275, in Jan. 1890 had grown to 100 companies using 72,800 lights. The long distance alternating system was placed upon the market in 1887, and on Jan. 1, 1888, the Thomson-Houston Co. had 23 stations, using this system, with 11,100 lights; in Jan., 1890, there were 237 companies, using a total of 209,000 lights.

Among the other exhibits were the following: A 1½ H. P. motor running off of a 110-volt incandescent current, with a speed of over 2,000 revolutions per minute and yet noiseless and without "sparking;" and the Thomson recording Watt-motor, which registered the current passing through the lamps used in the T.-H. E. C. decoration as gas or water are measured, and indicating the quantity used in so simple a manner that any one could read. Messrs. Buell, Hill, Searles & Cotton, representing the western branch of the Thomson-Houston Co. deserve credit for the taste and skill with which their various specialites were exhibited.

The Hyatt Pure Water Co. has sold a filter plant to the Union Water Co. for the filtration of the water supply of Beaver Falls, Rochester and vicinity, in Western Pennsylvania. The Hyatt Co. has also contracted for plants for the City of St. Thomas, Ontario, and the Cambria Steel Co., at Johnstown, Pa.

The American Equipment, Storage and Warehouse Co., 10 Wall St., New York, has been organized to store and properly care for all kinds of railroad equipment, with its warehouse at Lake View, near Patterson, N. J. The rates cover storage and insurance. For locomotives the rate ranges from $6.50 to $14.50 per month, according to value; for passenger cars, $7.50 to $11.50; street-cars, $3 to $4; freight cars, $3 to $3.50. The company also act as a clearing house for builders of rolling stock, mills, etc. President, O. B. Colton; Treasurer, J. D. Mitchell.

The Industrial Works, of Bay City, Mich., report the completion of a 35-ton wrecking and construction crane and a standard extension pile-driver for the Kansas City, Wyandotte & Northwestern R. R.; sending steam shovels and pile driving machinery to the Nicaragua Canal, and other wrecking cranes to the Cin., Saginaw & Mackinaw R. R., the Michigan Central R. R., Des Moines Union roads, Del. & Hudson Canal Co., etc. They have also completed steam shovels for the Flint & Pere Marquette and the Charleston, Cincinnati & Chicago Rys., and pile drivers for the Union Pacific and Zanesville & Ohio Rys., with large orders yet to fill from the Chicago, Milwaukee & St. Paul, Chicago, Burlington & Quincy and Kentucky Central Rys.

The Lidgerwood Mfg. Co., of New York, report a business of three to five engines per day. They will hereafter be represented in Utah, Montana and Idaho by Fraser & Chalmers, dealers in mining machinery.

The Berlin Iron Bridge Co., of East Berlin, Conn., has received the contract for the iron buildings for the Huanchaca Co., of Bolivia, South America, which will consist of a boiler house, 45 by 60 ft.; an air compressor house, 45 by 80 ft., and an engine house, 42 by 75 ft. These buildings will be made entirely of iron, put together in this country, taken down and shipped to Bolivia where they will be erected by native workmen.

Locomotives.—The Brooks Locomotive Works has an order for three locomotives for the new railway between Jaffa and Jerusalem.

J. B. Legg and John Niles, of St. Louis, have patented a new railway motor, with a combined underground conduit and electric wires. The conduit is a 7-in. cast-iron cylinder, laid as near the surface as possible, with a slot on top. Suspended inside are two hollow copper wires ⅝-in. outside diameter, conveying positive and negative electrical currents. Between these is a "traveler" conveying electricity to the motor on the car. Economy in plant is the chief claim of the inventors.

The Kingston, Ontario, Works, are making four 90-ton locomotives for the Chignecto Ship Ry.

Blood's Locomotive Works, of Concord, N. H., has delivered the first of an order of six heavy freight locomotives to a road not named.

Sewer Pipe.—The Knowles & Taylor sewer pipe works of East Liverpool, O., will probably remove to Denver, Col. A second English sewer pipe syndicate has obtained options on the remaining sewer pipe works in Toronto, O., and will secure about three-fourths of the stock, leaving one-fourth in local hands along with the local management. The preceding syndicate secured 9 works in Ohio and West Virginia.

The Spiral Weld Tube Works, of East Orange, N. J., has increased its capital stock to $1,000,000.

The Rivermont Land Co., of Lynchburg, Va., is proposing to build iron bridges, and has sold land to a car-building company and a Bessemer furnace company.

The Allegheny Bessemer Steel Works, at Duquesne, Pa., in May turned out 15,000 tons of steel rails. During the month the mill was idle but 36 hours for repairs. The Edgar Thomson mill was in operation eight years before it attained this record. The Duquesne plant has doubled its capacity since it was put in operation, not quite three years ago.

The Thomas Furnace Co., of Niles, O., will build a new and larger stack, 17x75 ft., the old stack being 16x71 ft., built in 1870 and enlarged in 1883. The new furnace will probably be in operation by the 1st of September, and will have a capacity of 200 tons daily. The Leechburg Foundry and Machine Co., of Pittsburgh, has the contract for all the cast-iron work.

The Pueblo, Cal., converter and steel rail mill has started on an order of 5,000 tons 75-lb. steel rails for the Denver & Rio Grande R. R. It is said an order for 16,000 tons has been booked for the Union Pacific R. R.

Cars.—The Minnesota Car Works have shut down, awaiting a settlement with the creditors of the New York Iron Car Co. The works may be reopened on their own account.

The Gilbert Car Works, of Green Island, N. Y., have turned out four coaches for a railway in New Zealand. This company has not yet decided what it will do with its works on the expiration of its present lease. It has the option of purchasing its present works on the expiration of its lease in Dec., 1891.

The Smith Capital City Wheel Co., of Columbus, O., will be ready by July 15, to turn out 100 to 125 sets of wheels daily.

The American Wheel Company, of Chicago, has purchased White's Wheel Works, of Fort Wayne, Ind. It is one of the largest wheel factories in the State. The same trust also controls N. G. Olds & Sons' works, of Fort Wayne, and now operates 14 plants.

The additional shops of the Union Pacific R. R., at Cheyenne, will cost $225,000. The contract for building them has been awarded to George East, of Cheyenne.

The Consolidated Car Heating Co. held its annual meeting at Albany on June 4, and elected Mr. George Westinghouse, Jr., a Director and Vice-President. This action effects the consolidation of this and the Standard Heating Co.

The Steel Truss Car-wheel Co. is erecting buildings and machinery at Edwardsville, Ill.

The Minnesota Iron Car Co., of Duluth, is building 50 flat and 10 box-cars for the Duluth & Winnepeg R. R.

Stevenson, Ala., Car Works.—Lalor Sherrey will organize a company in New York to build the steel car works.

New Incorporations.—Bluffton, Ala. Car-wheel works, with $50,000 capital and a capacity of 200 wheels per day. C. B. Parker, General Manager.

New Castle, Pa.—It is reported that the long-talked of steel plant is to be erected there this summer.

The Howard-Harrison Iron Co., of St. Louis, has been formed from the well known Shickle, Harrison & Howard Iron Co., of that city, to found an extensive plant at Bessemer, Ala. The parent company employs 1,000 men.

Topeka, Kan.—The Railway Frog and Supply Mfg. Co. Capital stock, $40,000. Directors: C. P. Baker, I. D. Cook, J. R. Moore and F. B. Johnson, of Topeka, and C. N. Baker, of Wamego.

Shelby, Ala.—The Alabama Feed Water Purifier Co. has been incorporated with a capital stock of $100,000.

Chicago, Ill.—The Illinois Electric Transmitter Co. to manufacture electric transmitters; capital, $1,000,000. Incorporators: William F. Sherman, Wm. S. Brewster and Stephen P. Gardner.

East St. Louis.—The Lake Shore & Ontario Smelting and Copper Mining Co.; capital, $5,000,000. Incorporators: Louis A. Coquard, Charles H. Peck, Jr. and Alexis C. Doltus.

Seattle, Wash.—Iron and steel works are to be erected opposite this place, at Kirkland, on the east shore of Lake Washington. Mr. L. S. J. Hunt is at the head of the movement, and says $1,000,000 will be expended on the enterprise.

Elizabeth, N. J.—The Union Car Mfg. Co. has been incorporated with a capital of $125,000. Its plant will be at Elizabeth, and the chief business office in New York City.

Switch Works.—The Cam-Lock Switch Mfg. Co. is being organized to establish works in Fort Payne, Ala., for the manufacture of the cam-lock switch. H. A. Hancock, 12 Pearl street, Boston, Mass., can give information.

A company has been organized at Chester, S. C., to manufacture the railroad lock signal invented by J. D. Perry.

The Ætna and Standard Iron Works, at Parkersburg, W. Va., are reported as sold to an English syndicate for $600,000 and $700,000 respectively.

A Gas Motor is being tried on the West Side Street Railway in Chicago. The gas is generated by stored naptha and is ignited by electricity. A speed of 15 miles per hour is claimed.

Metal Market Prices.—*Rails*—New York: $31 to $31.50 old rails, $24.20 to $25 for iron, $19 to $19.50 for steel. Chicago: $35; old rails, $24.50 to $25 for iron, $19 to $21 for steel. Pittsburg: $32 to $33; old rails, $25.50 for iron; $20 to $20.50 for steel.

Foundry Pig-iron.—Chicago: $15 to $16.50. Pittsburg: $16.25 to $17.50. Birmingham, $12.50. New York: $17 to $18.50.

Track Materials.—New York: steel angle bars, 1.75 to 1.80 cts.; spikes, $2 to $2.10; track bolts, 2.8 to 3 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.85 to 2 cts. for iron; spikes, 2.05, or 2.15 cts. delivered at Chicago or St. Louis; track bolts, 2.85 with square, and 3 cts. with hexagon nuts. Chicago: splice bars, 2 to 2.10 cts. for steel, and 1.90 cts. for iron; spikes, $2.00; track bolts 2.95 to 3 cts., with hexagon nuts.

Pipe.—Cast-iron, about $27 to $30 per ton, according to competition and amount of order. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York 4.35 cts.; Chicago, 4.20 to 4.25 cts.; St. Louis, 3.75 cts.

Structural Material.—Pittsburg: angles, 2.25 cts.; tees, 2.75 cts.; beams and channels, 3.10 cts.; sheared steel bridge plates, 2.95 cts.; universal mill plates, 2.40 cts.; refined bars, 1.90 to 2 cts.; steel plates, 4.25 to 4.75 cts. for fire-box; 3.15 to 3.20 cts. for flange; 3 cts. for shell, 2.75 cts. for tank.